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The Functional Activity of Single Units in the Central Nervous System: DR. J. F. FULTON 685

A Recent Drift in Biological Thought: PROFESSOR WM. A. KEPNER 692

Scientific Events:

The British Non-Ferrous Metals Research Association; Research Reserves in the National Parks; Summer Work of Members of the Division of Geology of Harvard University; The Dedication of Lakeside Hospital at Western Reserve University; British Birthday Honors 694

Scientific Notes and News 696

Discussion:

Evolution a Detail in the Dynamics of Populations: PROFESSOR W. H. LONGLEY. *Necessity of Organic Matter for the Maintenance of an Available Supply of Phosphorus in the Soil:* DR. A. H. MEYER. *Insects as Pollen Carriers:* DR. L. R. WALDRON. *Awards for Scientific Research by the Congress:* FRED R. JELLIFF. *New Technical Words:* W. A. DAYTON 700

Reports:

Twelfth Annual Meeting of the American Geophysical Union: JNO. A. FLEMING 705

Scientific Apparatus and Laboratory Methods:

A Simple Automatic Pressure Regulator for Filtration: EINAR LEIFSON. *Inexpensive Aerated Aquaria:* J. HENRY WALKER, JR. *Differential Filtration as a Means of Isolating Bacterium Granulosis:* DR. RALPH E. KNUTTI, DR. PETER K. OLITSKY and JOSEPH R. TYLER 707

Special Articles:

A Ration for the Production of Rickets in Chicks: PROFESSOR E. B. HART, O. L. KLINE and J. A. KEENAN. *An Investigation of "Insight" in Rats:* H. C. GILHOUSEN 710

Science News 10

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THE FUNCTIONAL ACTIVITY OF SINGLE UNITS IN THE CENTRAL NERVOUS SYSTEM¹

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WITH the recognition of the neurone as the ultimate anatomical unit of the nervous system it came to be tacitly assumed that all nervous and mental phenomena are, in the last analysis, explicable in terms of the combined activity of single nerve elements. Individual neurones, however, had, until very recently, eluded isolation as functioning entities, and knowledge of the intimate details of their behavior was therefore lacking. Without this information it was quite impossible to form a satisfactory conception of the elementary principles of nervous activity, and many details of reflex action remained obscure. Single muscle fibers, to be sure, had been studied by Lucas, Pratt and others to great advantage, and single

axones had been placed under direct observation by using artificial stimulation (pore electrode), but these studies gave little or no information concerning the characteristics of the nerve cell itself. The responses of a single intact neurone, activated within the central nervous system by a natural stimulus, were first placed under direct observation in 1928, and since then notable progress has been made in the analysis of their behavior. The quest of a single neuro-muscular unit has in fact had many of the dramatic features associated with the quest of the single atom, and the success achieved by the physiologist is in most respects quite as remarkable as that of the physicist.

Isolation of the unit was made possible largely by virtue of the electrical response accompanying activ-

¹ Schiff Foundation Lecture, Cornell University, April 17, 1931.

ity. The potentials developed by such microscopical units are small, but with modern valve-amplification this is a matter of little consequence; a much greater difficulty has been the anatomical isolation of the unit from the myriad of similar structures—nerve cells, nerve fibers, muscle fibers—surrounding it. This special problem is well exemplified by the early work on the voluntary electromyogram. Since every muscle fiber gives rise to an electrical response during activity, numerous and large electrical deflections can be obtained from a muscle, *e.g.*, the human biceps, during voluntary effort. A large number of studies concerning the nature of such electrical variations were carried out with capillary electrometer and later with the Einthoven galvanometer, and the attempt was made by Gotch, Piper, Garten, Forbes, Adrian and others, to infer the characteristics of activity of the individual nerve cells which had thrown the muscles into voluntary activity. In the early literature much of the discussion turned upon the existence of an alleged rhythm of approximately 50 per second which was commonly seen in the voluntary electromyogram (Fig. 1). At best, however, it was an

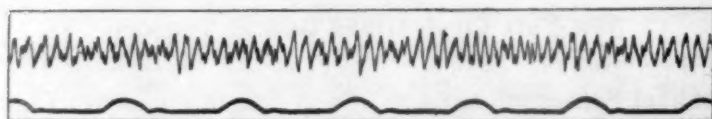


FIG. 1. An electromyogram of voluntary contraction of the flexor muscles of the forearm obtained by Piper. Note the rhythm of approximately 50 per sec. Time 0.20 sec. (H. Piper, "Über die Ermüdung bei willkürlichen Muskelkontraktionen." *Arch. f. Anat. u. Physiol.*, 491-498, 1909.)

"impure" rhythm, for there were many subsidiary vibrations ("secondary waves") thought to be due to elements out of phase with the majority. The real difficulty lay not here, but in the interpretation of the "primary" (50 per sec.) waves. There was no clear proof that they represented the responses of single units; it was quite possible that rotation of activity occurred among individual elements and that any given neurone might respond at a much lower rate than that indicated by the 50 per second rhythm. I had occasion six years ago to review the subject in some detail, and, in view of these and other considerations, I ventured at that time to make the following prediction:² "Not until the responses of individual units can be recorded singly will electrical records give a decisive answer as to rate of discharge of spinal motor neurones. Already, however, (1925) Adrian and Zotterman have succeeded in recording the action currents of a single proprioceptive afferent

² J. F. Fulton, "Muscular Contraction and the Reflex Control of Movement," Baltimore: Williams & Wilkins, pp. 477-478.

nerve fibre responding to an adequate stimulus (stretch) applied to its end-organ. In addition to the importance of so great a technical achievement, it also promises that a definitive solution of the long-debated question of the intrinsic rhythm of spinal centers may be reached in the near future." The inference was an obvious one and I can take little credit for its unexpectedly prompt justification, since it has come about through the ingenuity and foresight of other investigators.

While studying the stretch reflex³ of the red fibered soleus muscle (cat), Denny-Brown⁴ observed that on applying very slight degrees of stretch to the tendon a regular sequence of small galvanometer deflections was obtainable from the muscle (Fig. 2). He cor-

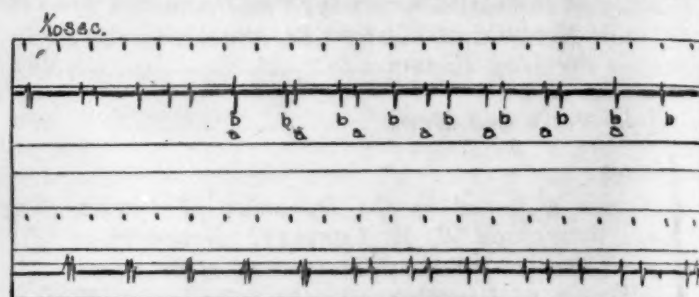


FIG. 2. The electrical response of single units of soleus muscle responding to slight stretch; string galvanometer record unamplified. In A the unit 'a' drops out toward the end of the record and unit 'b' persists. In B the waxing and waning of two units discharging at slightly different rates is clearly seen (Denny-Brown).

rectly interpreted these as being due to the activity of the group of muscle fibers innervated by a single anterior horn cell of the spinal cord. When the stretch stimulus was slightly increased a second group of action currents usually appeared maintaining a different rhythm from the first, and therefore waxing and waning with the first series of deflections (Fig. 2). It was quite evident that the second series of deflections represented the activity of an additional motor unit. With further stretch more units come in and the electrical deflections ultimately become quite confused and irregular.

Working independently of Denny-Brown, Adrian and Bronk⁵ succeeded, at approximately the same time, in obtaining from nerve the action currents of single discharging units. Their observations as to rate of discharge, waxing and waning of discrete rhythms, etc., entirely confirmed, and in some respects

³ E. G. T. Liddell and C. S. Sherrington, "Reflexes in Response to Stretch (myotatic reflexes)," *Proc. Roy. Soc. B/96*: 212-242, 1924.

⁴ D. E. Denny-Brown, "On the Nature of Postural Reflexes," *Proc. Roy. Soc., B/104*: 252-301, 1929.

⁵ E. D. Adrian and D. W. Bronk, "The Discharge of Impulses in Motor Nerve Fibers. Part II. The Frequency of Discharge in Reflex and Voluntary Contractions," *Jour. Physiol.*, 67: 119-151, 1929.

(to be considered later), considerably extended the work of Denny-Brown. Before describing the details of these important observations, we must pause to discuss the anatomical basis of the so-called "motor unit." It was a matter of some surprise to realize that a string galvanometer, without the aid of valve-amplification, was capable of registering the action currents from such a unit.

THE MOTOR UNIT⁶

Denny-Brown's observation was in harmony with the belief that a motor nerve fiber, through peripheral bifurcation, generally innervates a relatively large number of muscle fibers. However in 1928 very few direct observations were available from which an exact calculation could be made. The early (1873) estimates of Tergast^{7, 8} and others had not taken into consideration the existence of a large proportion of sensory fibers in muscle nerves. But in the case of the tenuissimus muscle it was evident from the data of Porter and Hart⁹ and Adrian,¹⁰ that as many as 140 to 160 muscle fibers must be innervated by a single motor nerve fiber.² This presupposed extensive peripheral dichotomy, the existence of which was made quite clear by the observations of Cooper,¹¹ who studied the peripheral ramifications of motor nerve fibers in the frog and the cat. She encountered many instances of double branching and one instance of "trichotomy."

The problem of complete enumeration of all of the fibers in a given muscle with a view to determination of the "innervation ratio" has recently been undertaken by D. A. Clark.¹² Using cats whose hind limbs had been desensitized by removal of all appropriate posterior root ganglia (in which therefore complete degeneration of all sensory fibers had occurred), he was able to count the motor nerve fibers accurately, and he developed an ingenious method for enumerat-

ing all of the muscle fibers, using two representative muscles, soleus and extensor longus digitorum. For soleus an innervation ratio of 1 to 120 was established and for extensor longus digitorum 1 to 155. This means that when a single anterior horn cell supplying the soleus muscle discharges, on an average 120 muscle fibers are thrown into action. This readily accounts for the facility with which Denny-Brown was able to secure action currents of a single unit.

One of the first questions that presents itself relates to the *tension* value of such a group of muscle fibers. How much tension can a single unit develop? It is obvious that this value will impose an absolute limit to the degree of fractionation of which the central nervous system is capable in respect of the muscle which it controls. Chronologically this particular problem was considered before the ratios of Clark were established, in a paper by Eccles and Sherrington¹³ published in June, 1930.

Using deganglionated preparations they measured, by means of an accurate torsion-wire myograph, the total tension developed during a twitch and in a tetanus of a group of representative muscles including soleus, extensor longus digitorum, and gastrocnemius. Afterwards, the motor nerve fibers supplying the muscle in question were enumerated and the value so obtained was divided into the total tension development previously observed. The figures arrived at for the tetanus were surprising and are indicated as follows:

	Gm.	No. units
Gastrocnemius (medial head).....	30.1	430
Soleus	9.9	200
Semitendinosus	5.5	630
Extensor longus digitorum	8.6	330
Crureus	10.2	250

For the *twitch*, values of approximately a third to a quarter of this amount were obtained. It is thus evident that a single anterior horn cell of gastrocnemius is capable of controlling as much as 30 grams of tension, being larger the larger the animal. On the basis of Clark's enumeration for soleus and extensor longus digitorum, it was possible to calculate a number of additional values, *i.e.*, weight per muscle fiber, and tension per muscle fiber, as indicated in the following table taken from his paper.¹²

Eccles and Sherrington also made a number of significant observations concerning the dichotomy of motor nerve fibers; thus on enumerating the number of myelinated fibers at various levels between the spinal cord and a given muscle, they observed a considerable

⁶ The phrase "motor unit" was introduced in 1925 by Sherrington who later defined it as follows: "The muscle and its nerve may be thought of as an additive assembly of 'motor units,' meaning by 'motor unit' an individual motor nerve fibre together with the bunch of muscle fibres it innervates."

⁷ P. Tergast, "Ueber das Verhältniss von Nerve und Muskel," *Arch. f. Mikros. Anat.*, 9: 36-46, 1873.

⁸ Tergast observed one nerve fiber to about three muscle fibers in the eye muscles of sheep, but a ratio of 1: 80 to 1: 120 for the limb muscles of the dog.

⁹ E. L. Porter and V. W. Hart, "Reflex Contractions of an All-or-None Character in the Spinal Cat," *Am. Jour. Physiol.*, 66: 391-403, 1923.

¹⁰ E. D. Adrian, "The Spread of Activity in the Tenuissimus Muscle of the Cat and in Other Complex Muscles," *Jour. Physiol.*, 60: 301-315, 1925.

¹¹ S. Cooper, "The Relation of Active to Inactive Fibres in Fractional Contraction of Muscle," *Jour. Physiol.*, 67: 1-13, 1929.

¹² D. A. Clark, "Muscle Counts of Motor Units: A Study in Innervation Ratios," *Am. Jour. Physiol.*, 96: 296-304, 1931.

¹³ J. C. Eccles and C. S. Sherrington, "Numbers and Contraction-Values of Individual Motor-Units Examined in Some Muscles of the Limb," *Proc. Roy. Soc., B/106*, 326-357, 1930.

Muscle	Weight per muscle fibre	Tension per muscle fibre	Tension per nerve fibre	Innervation ratio
M. soleus	mgm 0.122	mgm 84.0	grams 9.9	1: 120
M. extensor longus digitorum	0.072	48.5	8.6	1: 165

increase in the more peripheral cross-sections. This is well indicated in their diagram (Fig. 3) of the

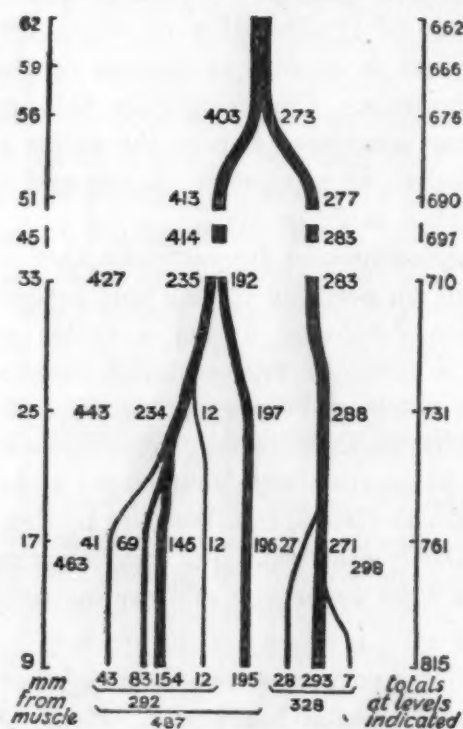


FIG. 3. Eccles and Sherrington's diagram showing their enumerations of fibers in the nerve to gastrocnemius medialis during 53 mm of its course toward the muscle.

deafferented nerve to gastrocnemius medialis, observed during 53 mm of its course toward the muscle. At the beginning it had 662 motor fibers and at the distal point examined, 815.

Eccles and Sherrington also observed that the motor fibers fell into two groups with respect to their size, a large number of approximately 4μ and a second group of roughly 14 to 15 μ . Both groups come through the anterior root and were unaffected by removal of the sympathetic ganglion chain. The presumption is that both the large and the small fibers innervate muscle fibers in the usual way through motor end-plates, and the question naturally arises as to the reason for these differing diameters. In studying the incidence of dichotomy Eccles and Sherrington found that the largest fibers were the earliest to divide in their course from spinal cord to muscle and that dichotomy was seldom encountered among the fibers of small diameter except it occur relatively near their ultimate terminations.

They were inclined therefore to believe that the large fibers, through extensive dichotomy, form the largest motor units. The small fibers, forming smaller motor units, serve to make the delicate adjustments necessary for muscular coordination. Eccles and Sherrington also infer that the total area of the large fibers gives an index of the total number of muscle fibers which they supply. Though only 66.3 per cent. in point of numbers, the large group form 92.4 per cent. of the total cross-sectional area. The presumption, therefore, is that the majority of units are large.

Denny-Brown was aware that the tension developed by single units was of the order of magnitude of 1 to 20 gms, but his levers did not permit accurate determination. The average contraction-tension per motor unit for the twitch of soleus in one of Eccles and Sherrington's anatomical estimates was 2.48 gms. With a specially devised eye-muscle myograph (torsion-wire pattern) Eccles and Sherrington¹³ were able to obtain stretch reflexes of varying sizes in response to a momentary tap on the table to which the muscle was fixed. A twitch-like response often appeared which was seldom less than *c.* 2.0 gms in tension (Fig. 4), and, if the tap were more intense,

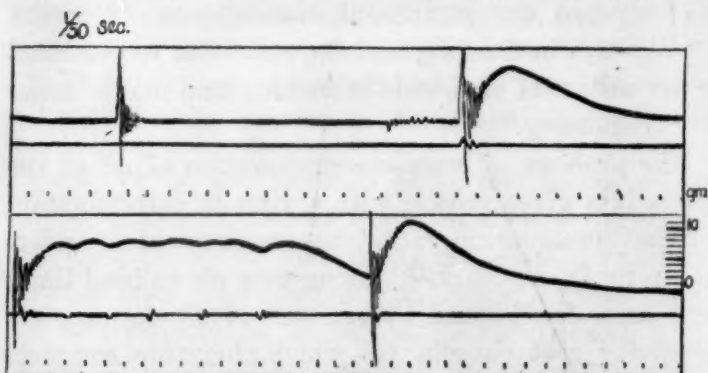


FIG. 4. Simultaneous electrical and mechanical record of units (2 to 3) of the soleus muscle (decerebrate cat) responding to a momentary tap. In the lower record a tetanic response is seen (Eccles and Sherrington).

larger responses occurred which, on measurement, proved to differ from one another by increments of 1.5 to 2.5 gms; thus in one of their figures showing a series of responses, the tension values were as follows: 0, 0, 2.5, 2.5, 4, 6.5, 6.5, 6.5, 6.5, 7, 8.7, 10.5 gms. From this they conclude (p. 352), "There seems no reason to doubt that the 2.5 gm. responses are twitches of single motor-units, and the 4 gm. responses of 2 units. Continuing the series it seems likely that 6.5-7 gm. is given by 3 units, 8.15 gm. by 4 units, and 10.5 gm. by 5 units. In this series 2.5 gm. is the greatest tension of a single unit and 1.5 gm. is the smallest. Further observations during the experiment accorded perfectly with these values; in all cases 1.5 or 2.5 gm. was the tension produced by a single unit." Occasionally in their experiments a firm tap

was *not* followed by a rise of tension (Fig. 4); in such a case there was no electrical response from the muscle, and, as they point out, this serves as an admirable control to the experiment: *i.e.*, there was either a response of *c.* 2.0 gm on the tension record associated with a 1 to 2 mm on the electrical record, or no response in either.

In some of their records *repetitive* responses (Fig. 4) were obtained involving single units, and the greatest tension registered did not exceed 10.4 gm and varied between that value and *c.* 7.0 gm. This is within the range which one would anticipate from the average contraction-tension per motor unit worked out on anatomical grounds (see above).

RATE OF DISCHARGE OF THE ANTERIOR HORN CELL

The most important disclosure from study of single units is their relatively slow rate of discharge. From observations on the voluntary electromyogram, and more particularly from reflex electromyograms in animals (in which responses had been taken *en masse* from the muscle as a whole), it had been inferred that nerve cells may discharge at rates varying from 50 to 500 per sec. It is certainly significant that with isolated units in "tonic" contraction no rhythm higher than 25 per sec. has ever been observed, and the majority have shown rates varying from 5 to 20 per sec.; thus, in Denny-Brown's record (Fig. 2), the first unit was discharging at 7 per sec. and the second at 5.5. In Eccles and Sherrington's tetani of soleus the highest rate seen was 13.7 (Fig. 4). To be sure, these observations were made on soleus, a relatively slow muscle, but the remarkable work of Adrian and Bronk⁵ confirms the values obtained, and we now propose to consider this work in detail.

By carefully dissecting a nerve trunk under a binocular microscope, Adrian and Bronk found it possible to transect all but two or three fibers so that only these remained in functional continuity with the nervous system. Leads were then taken from the nerve at points distal to the dissection, and with valve-amplification the responses of individual fibers were readily recorded by means of a capillary electrometer. Various muscle nerves were then examined under different forms of stimulation. During a *flexor* reflex (decapitate cat), evoked by pinching the foot and recorded from the nerve to peroneus longus, the discharge in a single unit was at first very slow, *e.g.*, 5 or 6 per sec., attaining at the end of 1 to 2 seconds a rate of 18 to 20 per sec., again subsiding as the stimulus of the foot was diminished (Fig. 5). In an *extensor* nerve (decerebrate preparation), *e.g.*, that to vastus lateralis, individual units were readily obtained which at rest discharged continuously for long periods at 20 to 25 per sec.; at the height of a crossed

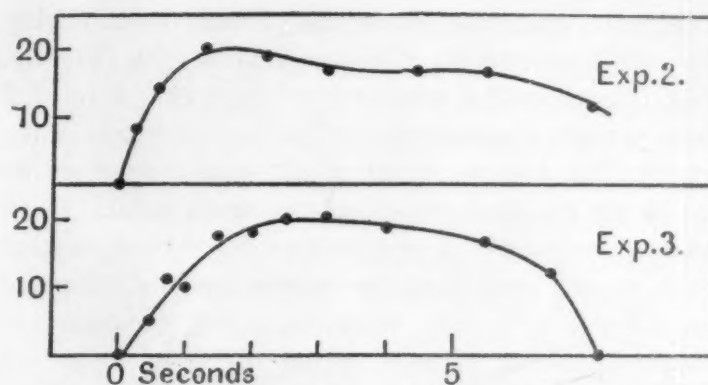


FIG. 5. Adrian and Bronk's curve illustrating the variation in the rate of response of a single unit of peroneus longus during a flexor reflex. *Exp. 2*, decapitate preparation; *Exp. 3*, decerebrate with spinal transection.

extensor reflex the rate might rise as high as 80 to 90 per sec., never above 100. This showed quite clearly that the stronger the stimulus, the more rapid the rate of discharge, and it was evident from this that *rate* of discharge is a highly important factor in the grading of contraction in skeletal muscle. It is a fact of some significance that alterations in rate were more readily demonstrated in extensor muscles than in flexors, for the extensors are called upon for more delicate adjustments of posture and movement than is generally required in the more primitive flexor reactions.

By another ingenious device Adrian and Bronk⁵ have succeeded in recording single muscle fiber groups in muscles whose nerves were not artificially cut down. They employed the expedient of a concentric needle electrode consisting of a small hypodermic needle into which was inserted a No. 36 gauge enamel wire (193 μ in diameter), the outside of the hypodermic needle forming one electrode and the exposed cut surface of the enamel wire, the other. In this way they suc-

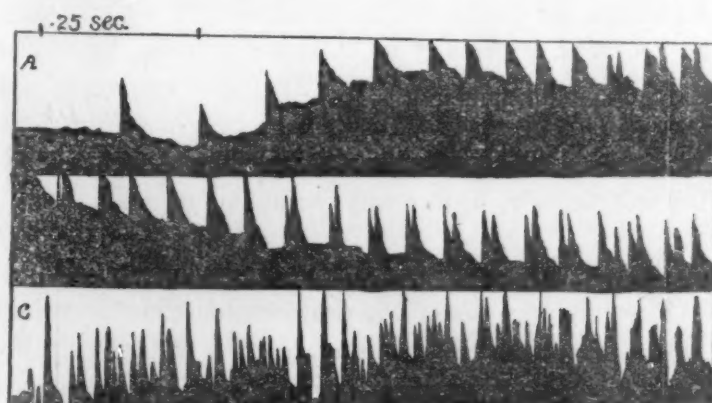


FIG. 6. Record of the development of a voluntary contraction of the human triceps obtained with the concentric needle electrode. In A one unit is responding, at first slowly and then more rapidly; a second unit then appears which in B is seen waxing and waning with the first. In C a large number of units are discharging (Adrian and Bronk).

ceeded in obtaining single and double units during voluntary contraction of human arm muscles (Fig. 6). Not infrequently a contraction began at a rate of 5 or 6 per sec., gradually increasing in magnitude as the contraction became stronger, ultimately reaching 30 or 40 per sec., and occasionally as much as 50. There was no evidence of a predominant 50 per sec. rhythm such as one sees when the muscle mass is examined as a whole (Fig. 1). Once more they demonstrated marked grading of rate during the development of contraction. With this technique they also re-examined certain muscles of the cat, including soleus, confirming Denny-Brown, and they also observed in quadriceps that a "tonic" discharge at a rate of 9 or 10 per sec. might persist for long periods of time without alteration in rate. Denny-Brown had indicated quite clearly that these so-called "tonic" responses were in reality stretch reflexes, for they disappeared when the muscle was caused to relax. Though its rate during a stretch reflex is usually remarkably constant, it may be diminished by application of a weak inhibitory stimulus (Denny-Brown), and I have several times seen soleus units slow down before dropping out of action on turning the head of the preparation away from the recording muscle, a manoeuvre which diminishes the resting tonus in the extensor muscles on that side (Magnus and de Kleyn).

With these characteristics of discharge in mind it is apparent that if more than a few fibers are brought into action, each one discharging asynchronously at a variable rate, the electrical result will be a complex series of deflections which would utterly defy analysis. Such records are readily obtained on gradually increasing a stretch reflex; first one unit, then another, later three or four come in, and ultimately a number so large that the electrical record is meaningless. The important outcome of the analysis of the rates of discharge are twofold: (1) Gradation of activity may be achieved, especially in extensor muscles, by variation in rate of discharge; (2) tonic responses are maintained by rates of discharge ranging from 5 to 15 per sec., at which rate a fiber can go on discharging indefinitely, apparently without fatigue.

OTHER CHARACTERISTICS OF THE MOTOR UNIT

Through analysis of the deafferented tibialis anticus muscle of the cat responding reflexly to two suitably timed, single break-shock stimuli applied to one of the afferent nerves of the hind limb, Eccles and Sherrington in a very recent series of studies^{14,15,16,17,18}

¹⁴ J. C. Eccles, "Studies on the Flexor Reflex. III. The Central Effects Produced by an Antidromic Volley," *Proc. Roy. Soc., B*/107: 557-585, 1931.

¹⁵ J. C. Eccles and C. S. Sherrington, "Studies on the Flexor Reflex. I. Latent Period," *Proc. Roy. Soc., B*/107, 511-534, 1931.

have thrown much new light upon the functional activity of the units involved in the flexor reflex. For convenience of designation we propose to follow their convention of referring to the first stimulus as C_1 and the second stimulus as C_2 .

Latent period.—They have confirmed the determinations of Jolly, and Forbes and Gregg for the "central reflex time" of the flexor reflex to C_1 as falling within the range of 2.75 to 4.35σ , the period being briefer the stronger the stimulus. If, however, C_2 falls within 4 to 36σ of C_1 the latency of C_2 is markedly diminished, and they have proved that the diminution occurs at the expense of the central reflex time. In some experiments it became as brief as 0.5σ , of which a small fraction must be due to conduction time within the nervous system, and the writers therefore conclude that the latent period of individual neurones may, in response to a second stimulus, be as brief as 0.2σ .

Refractory period.—Some writers have assumed that the neurone is without a refractory period. The work of Eccles and Sherrington indicates that this is emphatically incorrect. In their analysis of the reflex response of tibialis to two centripetal volleys they found, when C_1 was sufficiently strong, that C_2 produced a response of varying size depending upon the C_1C_2 interval, being least effective at about 14σ after C_1 (Fig. 7). They have brought forward a

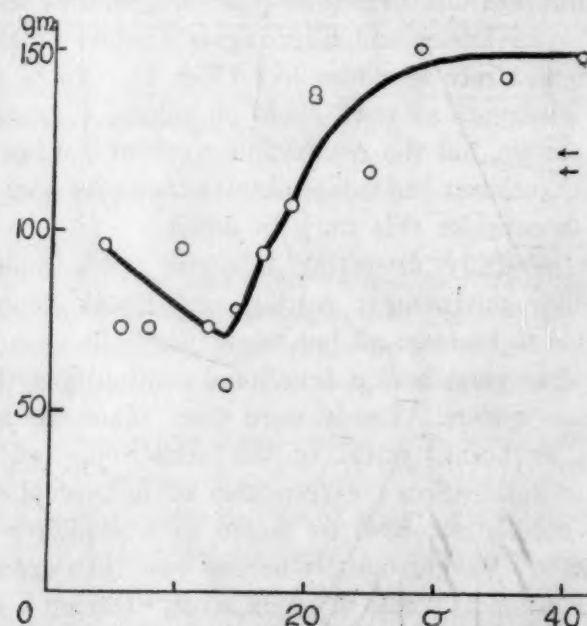


FIG. 7. Curve showing the tension evoked reflexly in tibialis anticus by a second stimulus following at intervals of 4 to 40σ after another stimulus of equal intensity. Note the "minimum" at 14σ .

series of convincing arguments to show that the greater effectiveness of C_2 at intervals less than 14σ

¹⁶ *Idem.* II. "The Reflex Response Evoked by Two Centripetal Volleys," *Ibid.*, 535-556.

¹⁷ *Idem.* IV. "After Discharge," *Ibid.*, 586-595.

¹⁸ *Idem.* V. "General Conclusions," *Ibid.*, 596-605.

is due to calling into action units not discharged by C_1 but which had been facilitated by that stimulus ("the subliminal fringe").¹⁹ Units discharged by C_1 are refractory during the greater part of this period. Following C_1 , therefore, two opposing processes go on concurrently in the center: (1) Dissipation of "facilitation" in the neurones of the subliminal fringe, and (2) recovery of excitability in neurones discharged by C_1 . This readily accounts for the "minimum" in the response, and the fact that it should occur at 14σ gives a clue to the approximate duration of the refractory period.

The evidence for this interpretation turns largely upon the response of the motor unit to an *antidromic* volley of impulses, *i.e.*, produced by a single stimulus applied to an intact (but deafferented) motor nerve. Eccles¹⁴ has shown that when a motor axon is stimulated in the reverse direction the anterior horn cell is made refractory to centripetal stimuli for a period of 10.5σ , of which 2.5σ represents an absolutely refractory period and *c.* 8σ a relatively refractory period. This new disclosure is one of considerable importance and has thrown quite a new and unexpected light upon the physiology of the neurone. When an antidromic stimulus is applied so as to reach the anterior horn cells between C_1 and C_2 (C_1C_2 interval being less than 14σ , *i.e.*, less than the "minimum") the response to C_2 was largely abolished even though the refractory period (10σ) of the antidromic volley could have had little effect. It is concluded from this that normally the response of C_2 must have depended upon an enhancement of the excitatory state produced in certain neurones by C_1 but not actually discharged by that stimulus. Eccles concludes also that an antidromic volley removes, in subliminally excited neurones, all traces of a preformed central excitatory state and causes the neurones affected to be refractory for a period of 10.5σ . The refractory state so produced is held to be identical with the refractory period following the normal discharge of a neurone. The slight discrepancy between the magnitude of the two values (10.5σ as compared with 14 to 15σ , the relatively refractory period of the reflex arc) is probably due to the greater degree of temporal dispersion of activity incident to stimulation of centripetal volleys.

When an antidromic volley falls during an after-discharge¹⁷ a period of complete quiescence occurs lasting not less than 20 to 50σ which is too long a

period to be explained by the central refractory period and must therefore be due to removal of the central excitatory state responsible for the repetitive discharge. In these circumstances all neurones are affected at once and the first sign of activity following the antidromic volley gives evidence of the least interval between successive impulses of the rapidly firing units. When the interval is as great as 50σ it clearly shows that no unit is discharging at a rate greater than 20 per sec. A second corollary is that after-discharge *per se* "depends on the continued arrival of delayed excitatory impulses" rather than on a supraliminal excitatory state. This places the cause of after-discharge further upstream in the reflex arc than the axon hillock of the anterior horn cell, but leaves it still one of the unsolved mysteries of reflex physiology.

Eccles and Sherrington's analysis of the reflex responses evoked by two closely concurrent centripetal volleys indicates that under strong repetitive stimulation from any source the summated rhythm, *e.g.*, the 50 per sec. response in the voluntary electromyogram, is probably due to an asynchronous rotation of units rather than to a group of units discharging at the observed rate. Adrian and Bronk's direct observations on the single unit in voluntary contraction of the human forearm indicate that the rate of discharge is highly variable and that little or no significance can be attached to the rates of discharge previously observed in the voluntary electromyogram.

THE CENTRAL EXCITATORY STATE

The recent experiments of Eccles and Sherrington allow us to reconsider the problem of excitation within the nervous system. They point out that the central excitatory process has many characteristics in common with the so-called local excitatory process in peripheral nerve, "Thus it seems likely," they remark, "that the central excitatory state is a specialised manifestation of the local excitatory state (*cf.* Sherrington, 1921). According to the membrane theory, the latter is a partial depolarisation of the polarised membrane surrounding the axis cylinders of nerve fibres, so on analogy central excitatory state is probably a depolarisation of those parts of the surface membranes of motoneurones on which the excitatory impulses impinge, *i.e.*, the synaptic membranes."

(There can be no doubt as to the close parallel between the central excitatory state and the local excitatory process in nerve. They are both due presumably to a local concentration of ions at a previously polarized interface but it seems to me necessary to draw a sharper distinction than Eccles and Sherrington have done between the polarized interface and the action upon it of ions leading to ex-

¹⁹ D. E. Denny-Brown and C. S. Sherrington, "Subliminal Fringe in Spinal Flexion," *Jour. Physiol.*, 66: 175-180, 1928. See also, C. S. Sherrington, "Some Problems attaching to Convergence." (The Ferrier Lecture). *Proc. Roy. Soc.*, B 105, 332-362, 1929; *idem.*, "Quantitative management of Contraction for 'Lowest-level' Coordination." (The Hughlings Jackson Memorial Lecture). *Brit. Med. Journ.*, i, 207-212, 1931.

citation. If the site of accumulation of ions responsible for the central excitatory state were the diffuse peripheral boundary of the nerve cell, which is inherent in their interpretation, I find it very difficult to understand how it is possible for an excitatory impulse reaching the cell at one point to summate with a similar impulse reaching the cell at a distant point; unless there is some special process of local conduction along the surface of the cell, this would be virtually impossible. If, on the other hand, one assumes a site of accumulation of ions common to impulses reaching the cell from every point and that all influence impinges ultimately at this point, the difficulties are minimized. I would urge further that the sharply circumscribed characteristics of refractory period, rate of discharge, etc., presupposes a discrete controlling center within the cell. However, the allocation of the central excitatory state to the region of the synapse has the logical advantage of placing it at the surface of the cell along which conduction is believed to occur. In offering an alternative interpretation, I do so, fully recognizing the inherent objections facing any theory of central excitation at the present time.

CONCLUSION

Single motor units, *i.e.*, anterior horn cells plus the muscle fibers they innervate, have recently been placed under direct observation while responding to a normal reflex stimulus. Details such as the normal

rate of discharge, latent period, refractory period, influence of fatigue, etc., have been carefully studied. The work of Denny-Brown, Adrian and Bronk, Eccles and Sherrington have all indicated that the natural rate of discharge of the anterior horn cell is slow, *i.e.*, 5 to 25 per sec., and never more than 80 to 90 per sec. under intense stimulation. (A motor unit discharging at 10 per sec. may continue in activity for indefinite periods of time without fatigue.) Tonic responses are maintained by such rates of discharge and therefore no special tonic mechanisms need be postulated to explain the absence of fatigue.

An individual anterior horn cell may, through peripheral bifurcation of its axon, command 150 or more muscle fibers, and it may, in consequence, develop during natural tetanus, a tension of 20 to 30 gms (*e.g.*, units of gastrocnemius medialis). In soleus, a red "postural" muscle,²⁰ the ratio of nerve to muscle fibers is 1 to 120 and the average tension value of the unit 10 gms. Direct observations of the tension developed by single units confirm the values obtained through anatomical averages.

The neurone has a refractory period of 10 to 15σ, which accounts for its normal slow rate of discharge. When an axon is stimulated antidromically¹⁴ the neurone becomes similarly refractory for a period of about 10.5σ and all evidence of a central excitatory state is removed by such a stimulus. The central excitatory state has many properties in common with the local excitatory process.

A RECENT DRIFT IN BIOLOGICAL THOUGHT¹

By Professor WM. A. KEPNER

UNIVERSITY OF VIRGINIA

At the close of the nineteenth century mechanism prevailed. The heavens no longer declared the glory of God but rather the marvelous phenomena that had accidentally transpired within the cosmic test-tube. Even the mind of man was but an epiphenomenon. It was the rattle of machinery. William Keith Brooks, in reaction to this mechanism, was frequently heard to remark, "Yes, my mind may be but the rattle of machinery, but what perplexes me is who hears the rattle?"

To modern physicists, the mechanism that prevailed three decades ago no longer appears to be satisfactory. Millikan closed his presidential address at Cleveland, last December, with the question "Has not modern physics thrown mechanism, root and branch, from its house?" and Jeans has placed a Creator back upon the throne. He says: "Everything

points with overwhelming force to a definite event, or series of events of creation. . . . The universe can not have originated by chance out of its present ingredients."

Modern biologists are yet striving to reduce vital phenomena to mechanical terms. Surface phenomena, colloidal phases and molecular changes are invoked, and that properly so, to explain these phenomena. But we must keep in mind that vital phenomena carry us beyond the ponderable. So our scientific efforts will not suffice when we come to consider all that life displays. Even an ameba carries us beyond the realm of science. Men have sought to explain the movement of this unicellular animal as the result of surface tension disturbances, of changes in colloidal states or of molecular changes. An

¹ Address delivered at the Virginia Academy of Science, April 24, 1931.

²⁰ D. E. Denny-Brown, "The Histological Features of Striped Muscle in Relation to its Functional Activity," *Proc. Roy. Soc., B*/104: 371-411, 1929.

analogy is seen between an ameba's rejection or ingestion of food and the rejection or acceptance of a glass filament by a drop of chloroform. If the filament be naked the filament will be rejected, but if it be coated with shellac it will be taken into the drop of chloroform in a manner that suggests an ameba's ingesting an algal filament. The movement of an ameba and the factors determining whether food and non-food be accepted or rejected are all proper subjects for scientific investigation. Some day I expect these phenomena to be reduced to physical and chemical terms. Science has not yet explained the manner in which the muscles of man contract. I expect that the contraction of the muscles of man will be reduced to physical and chemical terms in time. Both the ameba and man, however, carry one beyond the limitations of science in their respective activities. When a man seeks to lay hold of a non-motile object he approaches it directly. A man seeking to lift a fountain pen, for example, does so directly. When, however, he attempts to lay hold of an animal that may escape, his approach is indirect and he endeavors to meet the contingency of escape. The ability of man to so move in order that he may meet the contingency of escape on the part of an animal is fraught with the idea of teleology or purpose. Science, as such, can not deal with teleology and purpose, but biology may have to do so.

With the aid of my students I have been able to observe that an ameba is very much like man in this respect. Ameba's food-reactions fall into two categories. When an ameba encounters a food-object—plant or animal—that is non-motile its reaction is direct. It intimately surrounds the object. When, however, a motile object of prey is encountered, the reaction may be quite varied and is always indirect. If, for example, the ameba encounters a quiet *Chilomonas* or *Paramecium* it will surround it with a wide embrace and cut off all lines of escape before the prey is disturbed. So varied and so frequent have been the reactions of this type that we have observed in our laboratory, that I am prepared to make the significant statement that the unicellular animal, *Amoeba proteus*, meets contingencies. This fact carries us beyond science, whether we like it or not.

These observations stand in contrast to the observations of a southern anatomist, who was in the habit of telling his auditors that he had dissected many human bodies and had never found a soul. Over against this I may remark that I have studied many amebas and have never failed to find more in them than that that occupied space, namely, the ability to meet contingencies.

All living things present this apparent teleology.

It is because of this that biologists must so frequently use the phrase "in order that." Physicists and chemists can get along with the phrase "as a result of."

The physicists tell us that sand collects in an eddy as a result of the forces that are playing upon it; but a biologist sees that a shelled ameba (*Diffugia*) collects sand in order that its child may have microscopic stones with which to build its house.

Sticks and straws drift before the wind as a result of the energy exerted by the currents of air; but a robin collects sticks and straws in order that it may establish a home for its nestlings.

The moon shines as a result of the sun's light being reflected; but youths go out into the moonshine in order that ———!

All this implies a teleology or a purposiveness that even the mechanists can not get away from; for examine the biological writings of the most ardent mechanist and see how frequently one encounters the phrase "in order that" and how earnestly he writes in order that he may carry conviction.

But I shall not be content with citing the fact that a subtle teleology creeps into the writings and efforts of biologists who would avoid it. I have made some very significant observations, in this respect, upon a small turbellarian worm known as *Microstomum*. It has been found that this animal eats hydrae primarily for the "stingers" (nematocysts) of the latter. A *Microstomum* lacking "stingers" readily eats hydrae. *Microstoma* loaded with "stingers" will only with difficulty be made to eat hydrae. In this case, however, the "stingers" will be regurgitated. It has been demonstrated that the "stingers" of hydrae are actually used by the *Microstomum* that had appropriated them. Perhaps the most significant feature of *Microstomum's* ability to handle the "stingers" of hydrae is that it persists. *Microstoma* have been reared 22 asexual generations away from hydrae. Had all the individuals of these 22 generations been kept there would have been a population of 2,096,752 individuals. Only one of these potential animals was chosen for observation. This one had now been removed by 21 generations from experience with hydrae and its "stingers." And yet it ate a hydra and appropriated its nematocysts. Another line was maintained away from hydrae for 16 generations. Had all the individuals of these 16 generations been kept, there would have resulted a population of 32,768 individuals. One of this potential population was selected for experimentation. Its middle third was cut out and cared for. The anterior and posterior thirds were rejected. In time, the middle third had developed a new head and a complete body. The

resulting animal thus had a new central nervous system and had been removed from experience with hydrae by 15 generations. And yet it accepted a hydra and appropriated the nematocysts or "stingers."

This research has convinced me that life persists and is purposive.

Were I to have made this claim fifteen years ago, I should have had difficulty finding support in biological literature.

But times have changed. There appears to be a drift away from mechanism in modern biological thought. Haldane gives "freedom of the will" as one of four factors of evolution. Jennings says, "Emergent evolution does away with that monstrous absurdity that has so long been a reproach to biological science; the doctrine that ideas, ideals, purposes have no effect on behavior." Wells, Huxley and Wells, in "The Science of Life," record that, "Human purpose is one of the achievements of evolution" and that "Modern biology is steadily moving towards the con-

ception of a single world-stuff with both material and mental aspects."

In modern biological thought, therefore, purposiveness is coming to be recognized. Mind is no longer the clatter of machinery but an entity placed upon a par with matter. Less is heard these days of the cerebral cells secreting thoughts as the liver secretes bile than was the case twenty years ago. Biologists may come to realize that mind (life) is an entity with which they must deal as do physicists and chemists deal with matter. They may come to agree with Jeans when he says, "To-day there is a wide measure of agreement, approaching almost to unanimity, that the stream of knowledge is leading towards a non-mechanical reality; the universe begins to look more like a great thought than like a great machine."

The cosmic test-tube of the mechanists seems to have boiled over, and we find the purposiveness of Aristotle threatening to displace the mechanist's idea of chance survival.

SCIENTIFIC EVENTS

THE BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION

LORD RUTHERFORD opened the new headquarters of the British Non-Ferrous Metals Research Association in London on June 8, near Euston Station. The building provides space for the collection of machinery to assist the staff in carrying out its work. The following summary of his address is given in the *London Times*:

The quantity and quality of the work of the association in the past ten years, Lord Rutherford said, were surprising when the early difficulties of the organization were considered. It seemed to him that in future they must divide the work of the association under three categories: (1) *ad hoc* researches or special investigations bearing on the difficulties of the industry at a particular moment, which might help to improve a product or get over some technical difficulty; (2) long-range fundamental research bearing on matters that lay at the foundation of the industry; and (3), finally, the steady accumulation of knowledge that would lead to the creation of new industries or the development of existing ones. An association of that kind could not take short views.

Referring to the need for close liaison between scientific men and industrialists, Lord Rutherford noted how much had been done by the association to simplify the results achieved by research to the industrial mind. He regarded this as an important matter, because it restricted the inevitable time lag that occurred between scientific discovery and its use in industry. In estimating the results of scientific research there was always a

danger of taking too narrow a view of the work. They could not expect in research work a certain definite return every month. One of the marvels of the age was the development of the motor-car since 1900, on which tens of thousands of men were engaged to-day and for which special steels, special alloys and many other materials were required, each of them representing a great deal of research work. Of the 60 or 70 metals available for research only six or seven had been investigated by the association. What about the other 60? It was obvious that an enormous amount of work remained to be done.

There was probably not a single process that was going on in the industrial world that would not be capable of improvement if it were studied scientifically. He was quite sure that 90 per cent. of the processes used in industry could be improved by the application of science. In the new building there would be no lack of work in research for years to come, even if they multiplied the staff 10 to 20 times. The future of the metal industry, as of many others, was ultimately dependent on the application of science to industry. He thought that in the years to come only those industries would survive in the world which had shown their power of applying scientific knowledge to improve their methods of production.

RESEARCH RESERVES IN THE NATIONAL PARKS

A DEFINITE policy of preserving research reserves inside national park areas has been adopted by the National Park Service. The national parks themselves are areas preserved in as nearly as possible

their natural condition for the use of the people. The research reserves, however, carry the preservation a step farther, for in them it is proposed to maintain conditions unmodified and free from external influences of any sort, in order that their geologic and biologic exhibits may continue to be available in primitive form for the purposes of education and scientific investigation.

The research areas will not be approached by roads or trails, and will be located in isolated sections of the national parks where they will neither interfere with the administration of the parks nor with park use by the public.

Admission to these special areas, whose location will not be announced generally, will be by special permission only, and then only for the purpose of making scientific studies or in connection with the administration of the tract. The wild animals and plants in these perpetual reserves will be left absolutely unrestricted unless some invasion from the outside should seriously disturb the natural balance.

The idea of having these special research areas inside the national parks is not new, as the first one was established in the Yosemite National Park, California, in 1926. Another was established in Mount Rainier National Park, Washington, in 1928. While further reserves of this nature have been planned for several years, actual designation has awaited the formation of a definite policy in the matter and the making of the necessary field examinations and studies.

SUMMER WORK OF MEMBERS OF THE DIVISION OF GEOLOGY OF HARVARD UNIVERSITY

The Harvard Alumni Bulletin gives the following account of work planned for the summer by members of the Division of Geology:

Professor Percy Raymond will give a large part of the coming summer to the study of fossil crustaceans in museums of England, Scotland and Ireland. He sailed for England last month.

Professor R. DeC. Ward plans a short trip to several of the smaller islands of the West Indies in order to obtain first-hand information concerning their weather and climate. This "field-work" will be undertaken in connection with the writing of the chapters on the climatology of the United States, Mexico and the West Indies for the new Köppen-Geiger "Handbuch der Klimatologie." Professor Ward will be in Cambridge during the rest of the summer, writing his book on "The Principles of Climatology."

Russell Gibson, instructor in geology, will spend the summer in northwestern Montana, where he will examine mines and prospects and map a geology for the U. S. Geological Survey.

L. Don Leet, instructor in seismology, will devote the entire summer to the determination of the velocity of seismic waves in granite at Quincy, Massachusetts, and Westerly, Rhode Island, by recording on portable seismographs the vibrations set up by dynamite explosions.

Professor Kirtley Mather also will give some time to the geophysical research on the Quincy and Westerly granites, which is being carried on with the aid of a grant from the Milton Fund. Except for a few weeks' vacation on Mt. Desert Island, he will be at work during the rest of the summer on his new book entitled "South America, the Land and Its Resources."

Professor L. C. Graton will go to Canada early this month and continue his investigations of the geology of the ore deposits at the Hollinger mine, Porcupine, Ontario, and at the mines of the International Nickel Co., near Sudbury. Later in the summer, he expects to spend some time at the Hercules mine near Wallace, Idaho, and to visit a number of other western mining districts before returning to Cambridge.

Professor Donald H. McLaughlin will continue his geological work for the Homestake Mining Co. during the summer. Underground work at the company's large gold mine in the Black Hills of South Dakota will take six weeks or so, and a few additional weeks will be spent on mine examinations in Canada and in California. He will devote a few weeks to field work in the Tayoltita and Guanacevi districts in Mexico, where geological investigations are under way.

Professor Marland P. Billings will be on the staff of the U. S. Geological Survey during the summer. He will continue his work in the Rocky Mountains.

Professor Kirk Bryan will be in charge of the Harvard Summer School in the Jemez Mountains, New Mexico, from June 29 to August 8. He will spend the rest of the summer in the study of the physiography of the Rio Grande Valley (an investigation supported by the Shaler Memorial Fund) and somewhat later will prepare plans for an excursion for the International Geological Conference of 1933.

Professor Esper S. Larsen is at work in the field in California and will continue throughout the summer.

Professor D. S. Whittlesey expects to spend the whole summer in Europe, gathering material for a book he is preparing on economic geography. He plans to attend the International Geographical Congress in Paris, at which he will present a paper.

Harold S. Kemp, instructor in geography, will collect material throughout Central Europe, particularly in the Balkan States, to be used in the forthcoming "Geography of Europe," on which Professor Blanchard and he are working.

THE DEDICATION OF LAKESIDE HOSPITAL AT WESTERN RESERVE UNIVERSITY

THE formal dedication of the Lakeside Hospital group on June 17 brought to completion the Western Reserve Medical Center, on which the sum of \$15,000,000 has been expended.

From all sections of the country delegates of the leading scientific, medical, educational, social and civic organizations came to attend the ceremonies and pay tribute to the institution.

Representing the latest in architecture, design and equipment, Lakeside Hospital and its affiliated institutions are models of modern hospitalization. The Western Reserve University medical group is comprised of (in addition to the Lakeside group containing Lakeside Hospital and the Mather, Robb, Lowman and Harvey Houses, nurses' and physicians' quarters, and Hanna House, the private patients pavilion) the Schools of Medicine, Dentistry, Pharmacy and Nursing, Babies' and Children's Hospital, Maternity Hospital, the Institute of Pathology, Rainbow Hospital and the Power House and Service Building.

As a constant benefactor of the university and its great medical center, and one who for nearly half a century has been the chairman of the Lakeside Hospital Board, an illuminated appreciation was presented to Mr. Mather who presided at the dedication.

The address of dedication was delivered by Dr. Hans Zinsser, professor of bacteriology in the Harvard Medical School. Upon him Western Reserve University conferred the honorary degree of doctor of science.

The degree was also conferred on Dr. Samuel Clark Harvey, professor of surgery, Yale University School of Medicine; Dr. Evart A. Graham, professor of surgery, Washington University School of Medicine; Dr. Alphonse Raymond Dochez, professor of medicine, College of Physicians and Surgeons, Columbia University; Dr. David Marine, director of laboratories, Montefiore Hospital and assistant professor of pathology, College of Physicians and Surgeons, Columbia University, and Dr. Alfred Newton Richards, professor of pharmacology, University of Pennsylvania School of Medicine.

The doctorate of laws was conferred on Dr. Henry Asbury Christian, Hersey professor of the theory and

practice of physic, Harvard University Medical School, and on Dr. James Ewing, professor of pathology, Cornell University Medical College.

BRITISH BIRTHDAY HONORS

THE Birthday Honors List of King George, as reported in *Nature*, contains the names of the following men of science and others associated with scientific work: *Order of Merit*: Sir William Bragg, in recognition of his eminent services in the advancement of science. *Knights*: Dr. J. B. Baillie, vice-chancellor, University of Leeds; Colonel S. R. Christophers, director, Central Research Institute, Kasauli; Dr. W. C. D. Dampier-Whetham, fellow of Trinity College, Cambridge; Dr. P. C. Varrier-Jones, founder and medical director of Papworth Village Settlement for the Treatment of Tuberculosis; Professor S. R. Krishnan, King George V. professor of philosophy, University of Calcutta; Professor H. Lamb, emeritus professor of mathematics in the University of Manchester; Mr. C. R. Peers, president of the Royal Society of Antiquaries; Mr. R. L. Robinson, vice-chairman and technical commissioner of the Forestry Commission. *C.I.E.*: Dr. L. C. Coleman, director of agriculture, Mysore State; Mr. A. McKerral, director of agriculture, Burma; Mr. C. A. Malcolm, chief conservator of forests, Central Provinces, India. *C.B.E.*: Dr. Kate Barratt, principal of Swanley Horticultural College, Kent; Mr. W. J. Hadfield, city engineer and surveyor, Sheffield, a pioneer in modern developments of highway engineering and road surfacing; Professor H. M. Halls-worth, David Dale professor of economics, Armstrong College, University of Durham; Dr. Alice Werner, lately professor of Bantu languages at the School of Oriental Studies, London. *I.S.O.*: Mr. W. H. Moorby, assistant civil engineer-in-chief, Admiralty; Mr. J. B. Scrivenor, director of the Geological Survey, Federated Malay States.

SCIENTIFIC NOTES AND NEWS

THE doctorate of science was conferred by Harvard University at commencement on Dr. Harvey Cushing, Moseley professor of surgery. In conferring the degree President Lowell said: "Adroit with both the scalpel and the pen, a charming writer and the most renowned cerebral surgeon in the world."

At the commencement exercises of the Massachusetts State College, the honorary degree of doctor of science was conferred on Dr. Charles S. Howe, formerly president of the Case School of Applied Science, Cleveland, and on Dr. Joseph L. Hills, dean of

the College of Agriculture of the University of Vermont.

THE doctorate of science of Bowdoin College was conferred on June 18 on Dr. Isaiah Bowman, director of the American Geographical Society, New York.

At Dartmouth College the degree of doctor of science was bestowed on Dr. William Patten, professor of zoology at the college, who retires this year after serving for forty years, and on Dr. Lawrason Brown, of Saranac Lake, New York, specialist in the treatment of tuberculosis.

DR. HERBERT V. NEAL, professor of zoology and dean of the Graduate School of Tufts College, has received the doctorate of science from Bates College.

THE degree of doctor of science was conferred at the Yale University commencement on Dr. Eugene Lindsay Opie, professor of pathology and head of the department at the University of Pennsylvania and director of the Henry Phipps Institute, Philadelphia, and on Dr. John Ripley Freeman, of Providence, Rhode Island, civil engineer.

DR. BERTHOLD LAUFER, a member of the staff of the Field Museum for the past twenty-three years, was awarded the degree of doctor of laws at the one hundred and sixty-fourth convocation of the University of Chicago. The citation of Dr. Laufer was "in recognition of his distinguished service to science as curator of anthropology in the Field Museum of Natural History and especially of his scholarly and illuminating contributions to the study of the archeology, ethnology and philology of Asia."

WESLEYAN UNIVERSITY conferred the doctorate of science on Dr. Raymond Dodge, of Yale University, formerly professor of psychology at the university, and on Dr. Albert Francis Blakeslee, of the Carnegie Station for Experimental Biology (Wesleyan, 1896). President McConaughy pronounced the following characterizations as the degrees were conferred: On Professor Dodge: "Internationally known for your exact experimental work, largely responsible for Wesleyan's eminence in psychology, after twenty-six years here we lent you to Yale for leadership in her Psychological Institute and the Institute of Human Relations." On Dr. Blakeslee: "Trained by Professor Conn, scientific investigator in Europe and South America, leader of the work in biology and genetics at the Carnegie Station for Experimental Biology, president of the American Society of Naturalists."

DR. IRVING LANGMUIR, of the General Electric Company, has been elected an honorary member of the German Chemical Society, Berlin.

DR. EDWARD B. STEPHENSON, physicist in the sound division of the Naval Research Laboratory, Bellevue, Washington, D. C., was recently awarded a cash bonus of \$2,000 by the Navy Department for his contributions to the technique of preparing quartz crystals for use in controlling the frequency of radio transmitters.

DR. ALBERT RUSSELL MANN, dean of the New York State Colleges of Agriculture and Home Economics at Cornell University, will resign these offices to become provost of the university, a newly established position designed to relieve the pressure on the office of the president.

DR. ALFRED STENGEL, a past president of the American College of Physicians, has been appointed vice-president for medical affairs at the University of Pennsylvania.

DR. RALPH W. CHANEY has been appointed professor and chairman of the department of paleontology at the University of California. The appointment takes effect on July 1. Dr. Chaney will assume the position which was for many years held by Dr. John C. Merriam, now president of the Carnegie Institution, and more recently by William Diller Matthew, whose death occurred on September 24. He will continue his research relationship with the division of plant biology of the Carnegie Institution of Washington.

DR. FREDERICK C. LEONARD, of the University of California at Los Angeles since 1922, has been appointed chairman of the newly created department of astronomy.

DR. ROYAL N. CHAPMAN has been appointed dean of the newly organized Graduate School of Tropical Agriculture at the University of Hawaii. The new school will have library, research and laboratory facilities with an estimated value of a million dollars, as the result of an agreement to pool the resources of the University of Hawaii, the Bishop Museum and the Experiment Stations of the Hawaiian Sugar Planters Association and of the Association of Hawaiian Pineapple Canners. Instruction will be given in the sciences fundamental to tropical agriculture. The faculty includes Dr. Oscar N. Allen, Dr. Leonora N. Bilger, Dr. Walter Carter, Dr. Julius L. Collins, Dr. Francis E. Hance, Dr. Maurice B. Linford, Dr. Harold L. Lyon, Dr. Oscar C. Magistad, Dr. Albert J. Mangelsdorf, Dr. Christos P. Sideris, Dr. Harold St. John, Cyril E. Pemberton, Otto H. Swezey and Harold A. Wadsworth.

It is announced in the *Scottish Geographical Magazine* that as from October next Mr. A. G. Ogilvie, at present reader in geography in the University of Edinburgh and joint honorary secretary of the Royal Scottish Geographical Society, will become professor of geography. This is the first professorship in geography to be established in a Scottish university, and represents the culmination of long-continued efforts on the part of the Royal Scottish Geographical Society.

At the annual meeting of the American Society for Pharmacology and Experimental Therapeutics, Professor George B. Wallace was elected *president* and Professor Velyien E. Henderson, of the University of Toronto, *secretary*. In accordance with the constitution of the Federation of American Societies for Experimental Biology, these two officers become the

president and secretary of the federation for the year 1931-32.

DR. JOHN L. MORSE, of Boston, was elected president of the American Society of Pediatrics at the closing session of the first annual meeting at Atlantic City.

MR. JULIUS DANIELS, assistant superintendent of the promotion department of the Edison Electric Illuminating Company, has been elected president of the Illuminating Engineering Society.

AT the annual meeting of the British Optical Society on May 14, Professor A. O. Rankine was elected to the presidency.

OFFICERS of the Royal Society of South Africa have been elected as follows: *President*, Dr. W. A. Jolly; *Honorary treasurer*, Dr. L. Crawford; *Honorary general secretary*, Dr. B. F. J. Schonland. Resolutions were passed at the recent annual meeting to protest against the recent reduction of the government grant to the society.

DR. E. V. MCCOLLUM, of the Johns Hopkins University, and Dr. Harry Steenbock, of the University of Wisconsin, will be delegates from the United States at a meeting called by the League of Nations to advise on methods for the standardization of vitamins.

DR. PORTER J. CRAWFORD, a field director of the International Health Division of the Rockefeller Foundation, who at present is directing the yellow fever campaign in Para, Brazil, has leave of absence which he expects to spend in the United States.

DR. JUNIUS HENDERSON, professor of natural history and curator of the museum of the University of Colorado, and Mrs. Henderson, have left for California, where they will spend the summer collecting mollusks.

A SCIENTIFIC expedition from Harvard University to Australia under the auspices of the Harvard Museum of Comparative Zoology and under the leadership of Professor William Morton Wheeler will leave New York on July 25 to make a study and collection of its fauna. Other members of the expedition include Dr. Glover M. Allen, associate professor of zoology and curator of mammals at the museum; Dr. Ira M. Dixon, medical officer of the expedition, and P. J. Darlington, Ralph Ellis and William Schevill, graduate research workers.

DR. E. T. WHERRY, professor of botany at the University of Pennsylvania, and Dr. F. W. Pennell, of the Academy of Natural Sciences of Philadelphia, have left for Council Bluffs and will spend the next three months in the field, in an effort to rediscover the places where early botanists first found many of the species of plants common to the West.

PROFESSOR WILLIAM MCDUGALL, of Duke University, delivered the Ludwig Mond lecture at the University of Manchester on May 19.

DR. HARRY WALDO NORRIS gave the commencement address at Grinnell College on June 8, in commemoration of his forty years of teaching service as professor of zoology in that institution. Dr. Norris continues his connection with Grinnell College under the title of research professor of zoology.

THE Thomas Young Oration of the British Optical Society was delivered at the College of Science and Technology, South Kensington, on June 11, by Sir John Parsons, who spoke on "Young's Theory of Color Vision."

THE China Foundation with headquarters at Peiping has announced special research awards for the year 1931 to the following: Ren-chang Ching, authority on Chinese ferns, who is continuing work in the leading herbaria of Europe; Ching-yueh Chang, for his work on root anatomy. Te-pang Hou, Ph.D., chemical engineer of Tientsin, who is responsible for the first ammonia-soda plant to be established in the Far East; Chi-kung Jen, physicist, for work on the electron tube oscillator, and Hsien-wen Wu, zoologist, for his work on the fish fauna of South China. In addition to the above, the foundation has awarded twenty fellowships to Chinese research workers for special training abroad and has made a like number of fellowship grants for the support of research work at scientific centers in China. These awards are made by an advisory committee of scientific workers resident in China. This foundation was established in 1923 on the funds of the Boxer Indemnity returned to China by the United States government. Of the foundation's annual appropriations, about \$100,000 is devoted to research professorships and to the encouragement of scientific research.

MR. CYRUS H. K. CURTIS has made an unrestricted gift of \$1,000,000 to the University of Pennsylvania.

BY the will of the late O. M. Eidlitz public institutions receive direct bequests and remainder interests amounting to more than \$750,000. These include \$229,576 to the Presbyterian Hospital; \$153,050 to the Roosevelt Hospital, and \$54,666 each to the Hospital for the Ruptured and Crippled, Fifth Avenue Hospital, Manhattan Eye and Ear Hospital. Cornell University receives \$25,000 for a scholarship in the engineering department.

THE Soil Fertility Conference at the Pennsylvania State College, held in commemoration of the founding of soil fertility experiments at the college in 1881, opened on June 24. The speakers included F. D.

Gardner, C. F. Noll, J. W. White, A. L. Patrick, F. G. Merkle, F. J. Holben, C. D. Jeffries, all of the staff of the agronomy department, and Walter Thomas, plant chemist of the college; C. F. Marbut, U. S. Bureau of Chemistry and Soils; C. E. Thorne, formerly director of the Ohio Agricultural Experiment Station; A. B. Beaumont, Massachusetts Agricultural College; S. A. Waksman, New Jersey Agricultural Experiment Station; Richard Bradfield, the Ohio State University; J. A. Bizzell, Cornell University; Emil Truog, University of Wisconsin, and S. D. Conner, Indiana Agricultural Experiment Station; H. G. Knight, chief of the U. S. Bureau of Chemistry and Soils; J. G. Lipman, director of the New Jersey Agricultural Experiment Station; J. G. Patterson, director of the Maryland Agricultural Experiment Station; Enos H. Hess, president of Messiah Bible College, Grantham, Pennsylvania, and Frank M. Swartz, geologist at the college. Field trips were taken over the 144 plots in the 50-year-old experiment and an auto tour was arranged to Snow Shoe and Kylertown to observe experiments there. There was a reception to guests, and a banquet with Dean R. L. Watts, of the School of Agriculture, as toastmaster.

SIGMA GAMMA EPSILON, the national honorary geological fraternity, has accepted the petition of the Geological Society of Texas Technological College, and eighteen members of the group were recently initiated as charter members of the college's chapter of the fraternity.

AN economic and social survey of the southern Appalachian region, recommended by numerous public and private educational institutions, will be started this summer. The Bureau of Agricultural Economics will cooperate with the Bureau of Home Economics and Forest Service of the Department of Agriculture, the Office of Education, and several state experiment stations.

THE Royal Society of Canada at its recent convention in Toronto passed a resolution to the effect that Canada should establish three or four magnetic stations in the far north this year, while a dozen more should be established in other northern countries. One of the stations will probably be in northern Labrador, another north of Churchill, and a third at the mouth of the Mackenzie River. Each station will be manned by three to five men, with an expert meteorologist and physicist in charge.

The Geographical Journal, London, reports that, according to a statement made at the second annual meeting of the Canadian Geographical Society by the president, Dr. Charles Camsell, the society now has 29,801 members. The organization was completed in

the middle of 1929, and the society became active about the end of that year. Thus nearly 30,000 members have been enlisted in little over twelve months. The first issue of the *Canadian Geographical Journal* appeared in May, 1930, when 10,500 copies were printed; there was a subsequent reprint of 3,000 additional copies to meet the unexpected demand. 35,000 copies of the January, 1931, issue were printed for distribution to the society's members throughout Canada, Great Britain, the United States and elsewhere, the circulation covering no less than thirty-two foreign countries. The society's principal object is to disseminate knowledge of Canada's geography, resources, industrial development and economic possibilities.

The Experiment Station Record reports that the International Institute of Agriculture announces that a prize of 10,000 lire will be awarded annually for the best work on agricultural economics from a fund constituted in honor of the recent marriage of the Crown Prince of Italy and Princess Marie José of Belgium. The closing date for the submission of material for the first year is September 30, 1931, and the prize will be awarded on December 31. Participation will be restricted to works published within the two preceding years by authors belonging to countries adhering to the institute. The adjudication will be in the hands of a jury of five, consisting of the president of the institute and four members nominated by the permanent committee in such a way as to represent five different nations. Copies of the regulations and further information may be obtained from the president of the institute at Rome.

THE council of the senate of the University of Cambridge has made a long report to the university on John Humphrey Plummer professorships. It had been originally estimated that the income to the university from this source might be £10,000 a year. Since the time of Mr. Plummer's death the value of his estate has decreased. The council now consider that an annual income of £5,000 is a reasonably safe figure to take. The proposals which the council now lay before the university involve an annual expenditure of £4,260, and it is understood that the trustees would agree to this sum. The council accordingly has recommended "That the council of the senate be authorized to inform the Plummer trustees that the university would approve of the establishment in the university on the John Humphrey Plummer Foundation of professorships of inorganic chemistry, of mathematical physics and of colloid science, and of an annual payment at the initial rate of £300 from the Plummer Fund towards the maintenance of the department of colloid science."

The Experiment Station Record reports that an Agricultural Research Institute of Rumania was established under a law enacted in 1927 and formally organized in 1929. It now contains sections of phyto-techny and phytogenetics, chemistry, phytopathology and rural economics, and it is expected that these will be supplemented with sections on animal production and rural engineering. It has also taken under its direction the Central Agronomic Station at Bucharest; the agricultural chemistry, agricultural technology, seed control, and medicinal plants stations at Cluj; the phytopathology station at Chisinău; the newly established machinery testing station at Bucharest; the agricultural plant improvement and experiment stations at Jassy and Cluj, and agricultural experiment stations at Măreulesti and Tighina.

VISITORS from twenty-one foreign countries registered at the Petrified Forest National Monument in Arizona during the month of April, according to an announcement made by the Director of the National Park Service of the Department of the Interior. The countries represented were: Australia, Austria, Canada, Czecho-Slovakia, Denmark, England, France, Germany, India, Indo-China, Ireland, Italy, Japan, New Zealand, Norway, Poland, Singapore, Spain, Sweden, Switzerland and Venezuela. Visitors from every state in the union and from the District of Columbia also registered at the monument. The Petrified Forest National Monument is an eroded deposit of petrified logs said by scientists to be nearly two hundred million years old. Many of the petrified tree trunks found in the area are more than 100 feet in length. The indications are that some of these trees must originally have attained a height of more than 200 feet. Many interesting features of this ancient deposit of great tree trunks, cross sections of which reveal every color in the rainbow, have been uncovered by the work of erosion. One petrified log,

originally embedded in sandstone, forms a natural bridge, erosion having scooped out a small arroyo under the log. One of the three divisions of the area is called "Rainbow Forest," and chips of agate, onyx, carnelian and jasper are scattered over the ground in every direction.

THE Bird Sanctuary Committee of the Selborne Society, England, has made an urgent appeal for help in safeguarding the Brent Valley Bird Sanctuary, according to a report in the *London Times*. The founding of this reserve, the first of its kind, by the Selborne Society in 1902 set an example which has been widely followed, as the numerous nature reserves now in being attest, and many bird lovers wishing to make small sanctuaries of their gardens have been supplied by the society with boxes like those designed for the Brent Valley Sanctuary. In 1920, the bicentenary year of Gilbert White, of Selborne, the sanctuary was bought as a memorial to the father of British field natural history. The amenities of the Brent Valley Sanctuary will be safeguarded on the north and east by the welcome decision of the Middlesex County Council to keep adjoining fields as an open space. On the west, however, a factory has recently been built. Two fields on the south and south-east are now scheduled as factory sites, and unless the Selborne Society can buy them by June 1 the land will be sold. It is for the purchase of these fields on the south and south-east of the reserve that the Bird Sanctuary Committee is appealing. Most of the land in question, it is stated, could be used for playing fields if some benefactor would come forward in time to save it. For some time past the society has been trying to raise the necessary sum, but it still needs nearly £1,400 to secure the smaller field or £5,000 to secure both. The address of the honorary secretary is The Hermitage, Hanwell, W. 7.

DISCUSSION

EVOLUTION A DETAIL IN THE DYNAMICS OF POPULATIONS

As has already been pointed out,¹ known sorts of organisms are not a representative sample of the world population of species in their respective families and orders. The statement rests upon analysis of the taxonomic record of living Chiroptera, Ophiuroidea, Crinoidea, Decapoda and Cactaceae. The relative constancy of form of the curve of genera plotted by size in such groups permits the extension of the conclusion to the living world in general.

Two facts explain why matters stand as they do.

¹ SCIENCE, lxxii, 1858, 141, August 8, 1930; *Anat. Rec.*, xlvii, 3, 350, December, 1930.

First, the ranges of species of great genera are larger upon the average than those the species of lesser genera occupy. Second, collectors are impressed by the novelty of species of the smallest genera and, when working in the field, spare no effort to secure specimens.

As a result, in groups where the prevailing method of collection is mechanical, as it is when tow-net, dredge or trawl is employed, the greater genera are over-represented in the haul. But, in groups where the collector's psychology determines in part what shall be turned in for study and naming, genera least and greatest in size are both over-represented; and

others too large to permit their species to enjoy the one, and too small to allow them to enjoy the other advantage extremes profit by, are under-represented.

When this fact is recognized it becomes plain that the distribution of no peculiarity in the known sample certainly corresponds with its statistical distribution in the grand total of species. But, as the sample moves inevitably toward the total as its limit, all calculated distributions of attributes in it move toward actual distributions in the whole as their respective limits.

Now upon investigation it appears that the limiting form of the curve of genera plotted by the number of their species is a function of the normal curve. Pursuing this clue one finds that in all large natural groups of organisms, with whatever ability to maintain itself in the world the family or ordinal ancestor may have been endowed, the living species sprung from it have normal frequency distribution of the like ability. It is determinable also that though the species of small genera have on the average, when world population is considered, less ability than those of greater, in all local faunas and floras groups of species assorted by world size, or by local size of the genera to which they belong, have the same average ability to spread.

In the relations existing within systems of species one thus discovers the equivalents of dynamic relations holding within systems of molecules free to move. Both sorts of system show a tendency to attain a "normal state," to which they are bound to return after whatever disturbance. In each, for a given energy content, there is a single normal state attainable. In molecular systems in the normal state there is normal frequency distribution of component velocities along each of the three axes with respect to which actual velocities are conventionally resolved. Finally, in the inorganic system and the systems of species compared with it there is equipartition of energy among the different capacities to receive it.

This means that all that interplay of action and reaction which occurs between species and species, and between species and environment, and passes as a whole under the name of "struggle for existence," proceeds with an order as definitely predictable in its outcome as that manifested in a gaseous system under the terms of kinetic theory.

A kinetic theory of species is, indeed, as completely justified as a kinetic theory of gases, but before proceeding further we must for a moment consider a related matter, the mode of growth of populations.

As Pearl and Reed,² and Pearl and others have

shown, the process, whether in cultures of yeast and bacteria or in human populations, follows one law. This may be stated as follows:

In an environment of which the limited resources are constantly renewed every population tends momentarily to be augmented by a fraction which diminishes as the attained fraction of the limiting population increases.

But populations may not increase so, unless they are in fact as sensitive to fractional increases in population pressure as the formula requires. It is astounding, but a fact, nevertheless, that the measure of difficulty the generation of 1790 had in rearing its children in America should have gauged accurately the ultimate and largely unutilized resources of so great a country. Each later generation, however, so far confirms the ancestral experience.

The only factor of known power to modify the curve of a population's growth effectively is the exhaustion of resources, as Pearl has shown in experimental cultures of *Drosophila*, or the utilization of new resources, as when a population turns rather abruptly from agriculture to industry for its support. In either case a new maximum is set for the limiting population against which fractional increases are measured. That is all.

It is a fact of profound significance that the curve of population growth in the United States is unaffected permanently by the varying rate of immigration. From census to census the effect is *nil*. When a nation's resources permit a definite increase in the number of its people in a prospective unit of time, that increase and no more tends to be attained, whether or not the resident population be augmented in any degree by immigration.

In a mixed population the pressure equals the sum of the partial pressures, and the increase in pressure in the total population as it grows is equal to the sum of the increases in the partial pressures of its several components.

To say that the slope of the curve of population growth is a function of the limiting population, and has nothing to do with immigration, is simply to put the same fact in other terms. The steeply rising curves of population of the United States and of Russia, as contrasted with other less favored regions, merely reflect the richness of those countries' resources.

The effect of the law of partial pressures is evidenced again in the negative correlation between death-rate and birth-rate.³

Now grant molecules of any gas at zero pressure the power of producing others like themselves at a

² See Raymond Pearl, "Biology of Population Growth," Knopf, 1925.

³ G. Udny Yule, *J. Roy. Statistical Soc.*, lxxxviii, January, 1925.

rate determined by their inherent energy only. Let the power of increase fail by the attained fraction of a limiting pressure fixed in the beginning. Then the increasing number of molecules plotted against time will follow the logistic curve. And the addition of molecules from without, or arbitrary changes in the limiting pressure, will induce just such changes in the form of the curve as are registered by actual populations comparably treated. So we see why the growth of populations, human populations included, is subject to laws as little varying and in kind scarcely differing from the gas laws. Populations are simply more complex kinetic systems than physics usually deals with.

Large groups of species related by descent are kinetic systems even more complex than simple populations. They are populations of populations. Species are their elements. These elements are endowed with inherent energy and react with one another at haphazard in an ever-changing environment. The dependence of their mutual adjustments upon the law of chance is revealed in every detail of the equilibrium they momentarily maintain.

In gases, then—simple populations of organisms and populations of the second order—we have a series or hierarchy of kinetic systems of increasing complexity. The gas laws are the characteristic laws of the simplest of the three. The law of population growth expressed by the logistic curve is the new and distinctive law of the intermediate system. But the analogues of the laws of the lower system are inherent in this distinctive law of the higher. We may read them off by inspection:

The population pressure within a group of fixed size varies inversely with the volume it occupies in a uniform medium capable of affording support to a limiting population of definite size per unit volume.

In a uniform medium in which the diffusion of a particular sort of organism is rapid in comparison with its rate of reproduction, while the limiting population remains the same, equal volumes under the same population pressure include the same number of individuals.

The analogy between these and the gas laws they respectively suggest is due to the fact that the simplest gaseous systems and simple populations are each composed of elements of one sort, inherently energetic and attaining a stable state through the play of energy upon energy under the law of chance. That the higher system possesses its distinctive law is due to the fact that its units have one property or capacity significantly different from those of units of the lower. This is their capacity for multiplication at a rate dependent upon the attained fraction of the limiting population.

As the analogues of the gas laws are inherent in the law of the logistic curve, it remains to say that the law of the logistic is itself inherent in the law of evolution expressed graphically by the function of the normal curve so often mentioned. It is the power the new unit, the species, possesses—of variation for better or worse—which makes the new system with its new law possible. But with the new law of the highest system the laws, or analogues of the laws, of the lower prevail too. So in a very real sense evolution, stupendous phenomenon as it is, is a detail in the dynamics of second-order populations.

W. H. LONGLEY

GOUCHER COLLEGE

NECESSITY OF ORGANIC MATTER FOR THE MAINTENANCE OF AN AVAILABLE SUPPLY OF PHOSPHORUS IN THE SOIL

LABORATORY and field tests of the Louisiana Experiment Station indicate that the greatest problem of the upland soils of the South is of keeping the soil phosphates sufficiently available for the growing of cotton, even with the application of soluble phosphate fertilizers to the soil. It has been found that organic matter is more important from the point of keeping soil phosphates sufficiently soluble for plant growth than from any other point or points. With the depletion of organic matter, the soil phosphates as well as those added become less and less effective. The benefits ascribed to organic matter in the literature are indeed very important, but the rôle of the organic matter in keeping the soil phosphates sufficiently soluble for plant growth overshadows them all.

The problem of keeping the soils of the South in a high state of fertility is one that requires a program of farming that embodies the practice of green manuring in combination with the applications of the required plant foods. In soils depleted of organic matter even heavy applications of soluble phosphates do not have the desired effect. It is only with very heavy applications that a sufficiently high level of available phosphorus is maintained. In soils low in organic matter and high in the sesqui-oxides, the solubility of the phosphates is too low for the maximum growth of plants. It has been suggested that the soluble phosphates be applied in narrow bands to avoid immediate complete reversion, and this practice has given promising results. However, there are still some undesirable features to be worked out in such a practice. The less soluble phosphates, as precipitated tricalcium phosphates, have been suggested, owing to their slower rate of reversion. From a theoretical consideration they should give some promise.

It appears that the full fertilizer value of mineral nitrogen and potassium fertilizers can be obtained in

the absence of organic matter, more nearly so than with phosphorus.

In this connection it is of interest that the successful production of bananas is closely associated with available supply of phosphorus. Bennett's suggestion of pH is only correct in as far as the desirable pH is incidental to a high available supply of phosphorus.

The problem of the South and the Tropics of maintaining the fertility of their soils is one of maintaining a high amount of available phosphorus. The incorporation of organic matter is highly important with a judicious application of mineral plant foods. In other words, the partial and sometimes complete failure of fertilizer, particularly superphosphate, is usually due to lack of organic matter in the soil.

A. H. MEYER

LOUISIANA STATE UNIVERSITY

INSECTS AS POLLEN CARRIERS

Is it an instance of inheritance of acquired characters that we descendants of thrifty Yankee ancestors insist on finding "uses" for various objects in the universe? Nature, viewed by man, is the primary waster, in rather sharp contrast to the exactness with which her work is done. Dr. Frank Lutz, in a recent *Science Service* radio talk, "In Defense of Insects," deplors the method, wasteful and inefficient, of the production of vast quantities of pollen which is never used by anemophilous plants, only an occasional pollen grain finding a logical home. Dr. Lutz seeks to show the usefulness of insects in the economy of man, citing, in his argument, various plants, edible and otherwise serviceable, which depend for their genetic continuity upon insects that bring about cross pollination. Dr. Lutz, no doubt, knows his insects but perhaps he gives them somewhat too much credit for their beneficent attitude toward man so far as cross pollination is concerned. All important vegetable garden plants except corn, he tells us, come, directly or indirectly, from seeds resulting from insect pollination. This includes such plants as lettuce, the tomato, pepper, peas and beans, all of which are known to be self-pollinated, cross pollination by insects being the exception. The three textiles, linen, cotton and wool, are claimed by him as due to insects, the latter only indirectly. As a matter of fact, both the cotton and the flax plant are pollinated only occasionally by insects, depending mainly on their own resources and evidently well able to get along without insects at the present time. As for wool, practical sheepmen are not seriously concerned about clover in their pastures and no doubt many of the native legumes are self-fertilized. An important clover in New Zealand, *T. subterraneum*, is non-seed-bearing, while common red clover is not one of the

important legumes in the lush New Zealand pastures. Tobacco is another plant specifically mentioned by Dr. Lutz as insect-pollinated, but here again this plant, if it ever depended on insects, has learned to "roll its own"; pollen carrying insects are less its concern than are the aphids which carry its mosaic. Coffee, tea and cocoa plants may be insect-pollinated but judging by the above examples, which have really turned out to be "horrible," perhaps the chances are only even. Dr. Lutz scarcely mentions the part insects might have had in the phylogeny of the higher plants, but his statement that there was no extensive growth of land plants before insects became well established means nothing, except to a teleologist, for the primitive plants of the early land floras, which built the coal measures, could not have depended upon insects for progeny. Perhaps pollen-carrying insects have been important to plants mainly from an evolutionary standpoint and only incidentally do they remain important as accessory to seed production. Plant evolution would have proceeded without insects, but quite certainly the plant world is richer and more complex because of insect cooperation.

L. R. WALDRON

STATE COLLEGE STATION,
FARGO, NORTH DAKOTA

AWARDS FOR SCIENTIFIC RESEARCH BY THE CONGRESS

At the annual meeting of the Illinois State Academy of Science in Peoria, Ill., on May 8, the president made this statement:

I hope that the time will come when our government will establish not merely medal awards but substantial money prizes to be given annually to Americans who have made the most noteworthy and valuable research contributions and that present limitations on the time of ardent research workers will be removed.

I have reason to believe that a bill establishing such awards will be introduced by an Illinois member at the next session of Congress, and I trust that this organization will be the first to approve it, not from any selfish motive but as a grateful recognition of a great service rendered.

Later in the session, the following resolution was reported by the committee:

Realizing the large value and great importance of research along many lines and the benefits accruing to the people from inventions, explorations and discoveries in science, often the result of patient, persistent and painstaking endeavor,

Resolved, that the Illinois State Academy of Science, while fully appreciating the recognition accorded such work, would respectfully recommend that Congress add

to this the establishment of financial awards for the most noteworthy and valuable inventions and discoveries in the several branches of science, to be bestowed under such conditions as Congress may direct."

This resolution was unanimously approved.

As a matter of course the present situation with reference to such a measure is purely tentative, until details, if it is thought to be desirable, are worked out.

I have had some correspondence the last three or four months with Colonel B. M. Chipfield, congressman of the fifteenth Illinois district, on the subject and he wrote that he was favorably impressed. Since the meeting at Peoria he was written as follows:

I think that the measure will require a great deal of careful thought and collaboration on the part of those who are more familiar with the subject than myself. I stand ready to introduce such a measure at any time but I do not feel sufficiently familiar to draft it without considerable assistance.

Of course I do not mean the mere mechanical work of drafting the bill, which is easy enough, but as to what awards should be made, by whom, and for what I shall need advice and direction.

With all that Colonel Chipfield here says I fully agree. My idea in referring to it at all at the state meeting was based on the belief that ultimately something might be accomplished and that, if the matter were introduced at the next session and referred to a committee of Congress to act with a committee representing the American Association for the Advancement of Science, and the several other organizations of national scope, such as the National Research Council and the National Academy of Sciences, and to prepare the main features of a bill enumerating the number and scope of the awards and the lines for which they were to be made, the material would be in such shape as Colonel Chipfield suggests.

In the course of a year's study of the development along various lines of research, the prizes bestowed, the fellowships awarded, and medals given, I was impressed with the fact that the most notable of all is a foreign prize, the Nobel, and that the winning of this is a world distinction. There are many generous prizes in our own country, it is true, but they are established largely by individuals, associations and institutions and do not constitute a generous government recognition of a public service. It is true that medals are given and these of course are to be esteemed as tokens of honor and recognition.

I can imagine, however, what an award like the Nobel to the late Albert A. Michelson meant in the prosecution of such a work as he was attempting, if his own means and the limitation on his time would not otherwise have permitted it. It is, indeed, for-

tunate that we have institutions and museums that promote the work of research, invention, and exploration, and also that we have scientific publications that advance this cause.

But I think also of those with cramped means and limited time, who are engaged in invention, exploration, architecture, physics, astronomy, electricity, chemistry, geology, botany, medicine and surgery, and perhaps other lines of basic research, and who are struggling under adverse conditions to give the people the finished product of their thought and study, whom a government award or endowment or pension might greatly aid and encourage.

Dr. John C. Hessler, a former president of the Illinois State Academy of Science, has suggested that if such a bill is framed it might well include a clause that empowers the government to receive gifts toward such an endowment fund from which awards could be made, and it is possible that there may be many, who, desiring to emulate the example of the founder of the Smithsonian Institution, would gladly be contributors. Such contributors could be added to any appropriation that Congress might make.

But at present it seems to me that Congress at least could, as an initial step, be solicited to appoint a committee to act, as indicated, with a committee of leading scientists.

Personally I believe that such awards in research would inspire and stimulate and result in great good. It is farthest removed from my thought to commercialize science, but rather the idea is to give the best, the freest, the fullest opportunity to the ones most competent to give the world something worth while.

FRED R. JELLIFF,
Past President

ILLINOIS STATE ACADEMY OF SCIENCE

NEW TECHNICAL WORDS

IN the issue of *SCIENCE* for May 22 (73: 565-566) Messrs. Tester and Bay describe their ingenious instrument, "The shapometer: A device for measuring the shapes of pebbles."

As "shapometer" is an obvious hybrid, interdicted by good usage in fashioning word novelties, and inasmuch as we already have in use the words morphometry and morphometrical, it is hoped that the gentlemen referred to may be induced to adopt the name morphometer for their device (from Greek μορφή, form or shape, + μέτρον, measure). If that term be deemed specifically insufficient, the more definite word psephometer (from Greek ψήφος, a pebble, + μέτρον, measure) might be suggested.

W. A. DAYTON

U. S. FOREST SERVICE,
WASHINGTON, D. C.

REPORTS

TWELFTH ANNUAL MEETING OF THE
AMERICAN GEOPHYSICAL UNION

THE twelfth annual meeting of the American Geophysical Union and the sessions of its sections were held in Washington, D. C., on April 30 and May 1, 1931.

The Sections of Geodesy, Meteorology, Volcanology, Oceanography, Seismology, and Terrestrial Magnetism and Electricity held their meetings April 30. The Section of Hydrology met May 1, and the meeting was concluded with the general assembly of the union on the afternoon of May 1.

Seven papers presented before the Section of Geodesy were devoted largely to progress reports on absolute determination of gravity, Mexican gravity stations, gravity work presented at the Stockholm meeting of the International Union, on graduation and calibration of precision-circles, on the astronomical establishment of points on an unsurveyed boundary in Canada, and on geodetic work during the past year in the United States. Harlan T. Stetson presented also some further investigations of the moon's influence on latitude.

In the Section of Seismology, following the consideration of proposals for the international intercomparison of recently developed types of instruments and study of seismic sea-waves, an interesting series of papers and informal communications was presented, including a paper on the origin of earthquake-waves, progress reports on the development of instruments, the use of precise triangulation and levels in California in seismological investigations, the registration of time-signals, and velocity of explosion-generated longitudinal waves in nepheline syenite. The secretary reported that following the resolution adopted at the eleventh annual meeting a grant had been provided by the Carnegie Institution of Washington, through its Advisory Committee in Seismology, to establish a seismological observatory at the Huancayo Magnetic Observatory in Peru.

At the meeting of the Section of Meteorology the first five papers were concerned chiefly with the International Polar Year proposed for 1932-33, the remainder of the program being devoted to considerations of the proposed International Cloud Atlas, atmospheric turbidity, measurements of color of the sea and the sky, and cyclical variations in precipitation, runoff, and lake-levels, and their relation to long-range forecasting.

The papers presented before the Section of Terrestrial Magnetism and Electricity included progress

reports on the year's investigations and projects in the United States, a report on the proceedings of the International Section of Terrestrial Magnetism and Electricity at the Stockholm assembly, four papers bearing on extra-terrestrial considerations in the fields of the section, and four papers bearing on polar research. A significant feature of the first group was the indication of the large number of governmental, college, and commercial organizations in the United States and Canada which submitted progress reports, namely, twenty-one. The desirability of further magnetic and electric work in the polar regions of the earth and especially during the proposed International Polar Year of 1932-33 was indicated in the papers of the last group.

As in the other meetings, that of the Section of Oceanography was devoted almost wholly to progress reports of nine governmental bureaus and private research organizations engaged in oceanographic work, showing the wide-spread interest and rapidly increasing development. Besides these reports there were two papers telling of progress in Gulf Stream temperature-investigations and of the results obtained by duplicate measures of specific gravity of seawater by the Knudsen and Plummet methods.

Following a paper on the solubility of water in granite magmas, reports were presented to the Section of Volcanology on Merapi and its eruptions, volcanoes of Katmai district in 1930, the Tertiary volcano at Cripple Creek, Colorado, and the Valles Mountain volcanic center of New Mexico.

The first annual meeting of the Section of Hydrology, organized in November, 1930, was very successful and well attended. Following a brief account by the chairman on the organization, activities, and plans of the section, twelve papers were presented upon various scientific aspects of hydrology. Robert E. Horton's paper on "The Field, Scope and Status of the Science of Hydrology" developed excellently the scientific possibilities of the section's field. Other papers of the program emphasized the absorption of precipitation and its penetration, glacier-measurements, organization and work of various governmental hydraulic stations and laboratories, the need for closer cooperation among students of stream work, studies in evaporation, relation of ground-water hydrology and Pleistocene geology of the Platte River Valley and adjacent areas, significant studies in hydrology on the Pacific coast, and reports on investigations in progress in hydrologic laboratories.

The report of the general secretary at the general assembly of the union showed a total membership of

222 and gave some account of the relations of the union with the international body. At the fourth general assembly of the International Union of Geodesy and Geophysics held at Stockholm, Sweden, from August 14 to 23, 1930, there were present some 302 delegates and guests representing thirty-six countries. The United States was represented by a total delegation of 27, including 14 delegates of the union. The report showed that the interest in geophysics and geophysical applications has continued its rapid growth in the United States and that the activities of the American Geophysical Union have made substantial contribution in forwarding this growth. The general secretary also reported briefly on the progress of the plans for the Jubilee International Polar Year, on the Wilkins-Ellsworth Trans-Arctic Submarine Expedition, and on the cable advice recently received from the general secretary of Aeroarctic that the *Graf Zeppelin* was to make a polar flight leaving Germany July 20 for the purpose of testing equipment assembled for scientific observations in the Arctic, as a trial preliminary to the exploratory flights from Friedrichshafen to Fairbanks and return planned for 1933.

The following five resolutions were unanimously approved:

(1) *Resolution on gravity at sea* proposed by the sections of Geodesy and Volcanology—

WHEREAS, The United States Navy Department, in cooperation with the Carnegie Institution of Washington, conducted a gravity-campaign in 1928, during which observations were made under the direction of Dr. F. A. Vening-Meinesz, Member of the Dutch Geodetic Commission, at many points in the Caribbean Sea, the Gulf of Mexico, and the Atlantic Ocean to the northward of Porto Rico, thus adding materially to the knowledge of the crust of the Earth in the regions covered, and furnishing data for the figure of the Earth, and

WHEREAS, Much additional information about gravity at sea should be obtained, therefore be it

Resolved, That the American Geophysical Union of the National Research Council recommends to the Navy Department that it give thought to the question of continuing its work on gravity at sea and of securing the necessary soundings to supplement such work, especially in the waters of the West Indies including the Caribbean Sea, and be it further

Resolved, That a copy of this resolution be forwarded to the Secretary of the United States Navy.

(2) *Resolution on international cooperation in the study of tidal waves* proposed by the sections of Seismology and Oceanography—

WHEREAS, A communication has been received through the Department of State and the National Research Council from M. Hubert, Secretary of the Commission

of the International Union of Geodesy and Geophysics for the Study of Tidal Waves, suggesting and inviting participation of the United States in studying tidal waves and various phenomena associated with them, therefore be it

Resolved, That the American Geophysical Union indorses the plan of the Commission and recommends the participation by organizations and individuals of the United States who may be concerned, and in order that a suitable plan for such participation may be developed, the chairmen of the sections of Seismology and Oceanography are authorized to appoint two members from each Section as a joint committee, and be it further

Resolved, That a copy of this resolution be sent to the Secretary of the Commission of the International Union of Geodesy and Geophysics for the Study of Tidal Waves.

(3) *Resolution on comparisons of new types of seismological instruments developed in the United States with various types developed in Europe* proposed by the Section of Seismology—

WHEREAS, The Director of the Central Seismological Bureau of Strasbourg, France, has indicated the great desirability of direct comparisons of new types of seismological instruments developed in the United States with various types developed in Europe, and has offered the facilities of the Central Bureau for this purpose, preferably with the cooperation of an American seismologist, therefore be it

Resolved, That the American Geophysical Union indorses this plan, and be it further

Resolved, That a copy of this resolution be sent to the Director of the Central Seismological Bureau of Strasbourg.

(4) *Resolution commemorating fiftieth anniversary of General Greely's participation in the first International Polar Year* proposed by the Section of Meteorology—

WHEREAS, The American Geophysical Union is lending its influence toward the successful completion of the work of the Jubilee International Polar Year, 1932-33, and

WHEREAS, All the world recognizes in Major-General Adolphus W. Greely, U. S. A., retired, the leader of the Lady Franklin Bay Expedition, 1882-83, of the First International Polar Year, the outstanding figure in Arctic exploration on this continent, therefore be it

Resolved, That the American Geophysical Union record its high appreciation of General Greely's abundant contributions to our knowledge and its earnest wishes for the long continuance of his good health, and be it further

Resolved, That a copy of this resolution be sent to General Greely.

(5) *Resolution on the death of Franklin G. Tingley* proposed by the Section of Meteorology—

WHEREAS, The members of the American Geophysical Union have learned with profound regret of the death of

Franklin G. Tingley, late Chief of the Marine Division of the United States Weather Bureau, therefore be it

Resolved, That the American Geophysical Union record its profound regrets over this loss not only to its own personnel but also to the world of science in general, and especially to oceanography and meteorology, and be it further

Resolved, That a copy of this resolution be sent to Mr. Tingley's family.

The joint committee entrusted with the work involved in the resolution on international cooperation in the study of tidal waves consists of H. F. Reid, *Chairman*, Perry Byerly, N. H. Heck, and H. A. Marmer.

J. A. Fleming was reelected general secretary of the union to June 30, 1934.

The scientific session following the business session was devoted to a symposium on time-signals sponsored by the sections of Geodesy and Seismology. This symposium included the following papers and discussion:

(a) United States Naval Observatory time-service, by J. F. Hellweg; the *Chairman* expressed the thanks of the meeting to Captain Hellweg for his paper and his expressed desire to do everything possible in meeting the needs for more frequent time-signals.

(b) Time-signals for electrical and physical measurements, by Frank Wenner; discussed by Messrs. Bowie and Heyl.

(c) Time-signal needs for geodetic work, by Edwin J. Brown; discussed by Messrs. Bowie, Hubbert, Hellweg, and Brown.

(d) H. E. McComb, Secretary of the Section of Seismology, then read short communications from Messrs. James B. Macelwane (expressing regret that because of illness he could not prepare the paper "Time-signal needs of the seismologist"), H. O. Wood (two), and B. Gutenberg, all emphasizing the need of broadcasting time-signals at more frequent intervals and the necessity of carefully controlling wave-lengths to prevent variation from day to day; Messrs. Heck and Hellweg made detailed comments on these communications which were further discussed by Messrs. Brown, Sollenberger, and Reid.

(e) Establishment of world-time, by F. W. Lee (read by Frank Wenner); discussed by William Bowie.

(f) The service available from the standard-frequency transmitters of the Bureau of Standards, by J. H. Dellinger.

(g) The accuracy of the primary-frequency standard of the Bureau of Standards, by C. G. McIlwraith.

(h) Informal communications—Upon invitation of the *Chairman*, informal communications with particular reference to the papers presented in the symposium were given by Messrs. C. W. Horn of the National Broadcasting Company and H. A. Affel and Warren A. Marrison of the American Telephone and Telegraph Company and Bell Telephone Laboratories.

The marked success of the meetings of the sections and of the union hinged largely upon the excellence of the program developed and the arrangements made by the Committee on Meetings, consisting of Messrs. Frank Wenner, *Chairman*, H. A. Marmer and F. W. Sohon.

JNO. A. FLEMING,
General Secretary

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE AUTOMATIC PRESSURE REGULATOR FOR FILTRATION

In biology especially definitely controlled pressures on filters are very desirable in as much as the nature of the filtrate is determined not only by the kind of filter used but also by the pressure on the filter. In many instances biologists have neglected to state the pressure at which the filter was operated. The pressure may be regulated to some extent by the pump itself or by a hand-operated air leak. By neither of these means is a pressure obtained which is constant for any length of time. To improve the situation a simple pressure regulator has been devised by means of which a filter may be operated at any pressure for any length of time.

The whole apparatus is so simple that it can be made by any one whose ability at glass blowing does not much exceed the making of a T-tube. Fig. 1 shows a drawing of the apparatus. A 10 cc or 20 cc syringe (a partially broken one may be used) is cut

off at one or both ends. The plunger is also cut off. The longer the plunger is, however, the less oil will leak past it at high pressure. A glass tube *b* is fitted with a side arm and a guide as shown in Fig. 1. The guide is just a piece of heavy walled glass tubing cemented in place in tube *b*. Paraffin makes a satisfactory cement. Tube *b* is also provided with a slight flare at the top. Tube *a* may be either a solid or a hollow glass rod, preferably of such diameter that it fits snugly into the guide, but moves freely. If the rod is hollow, holes may be drilled above and below the guide to insure rapid equalization of the pressure throughout the system. If tube *a* fits loosely in the guide, no such holes are necessary. If tube *a* is solid, a groove may be cut along one side. The tube *a* is enlarged as shown in the illustration, and it is ground into tube *b* as a stopper is ground into a bottle. Over the ground end of tube *a* is fitted a piece of thin, soft rubber tubing. A very effective air valve is thus formed. To keep the valve closed a spring is placed

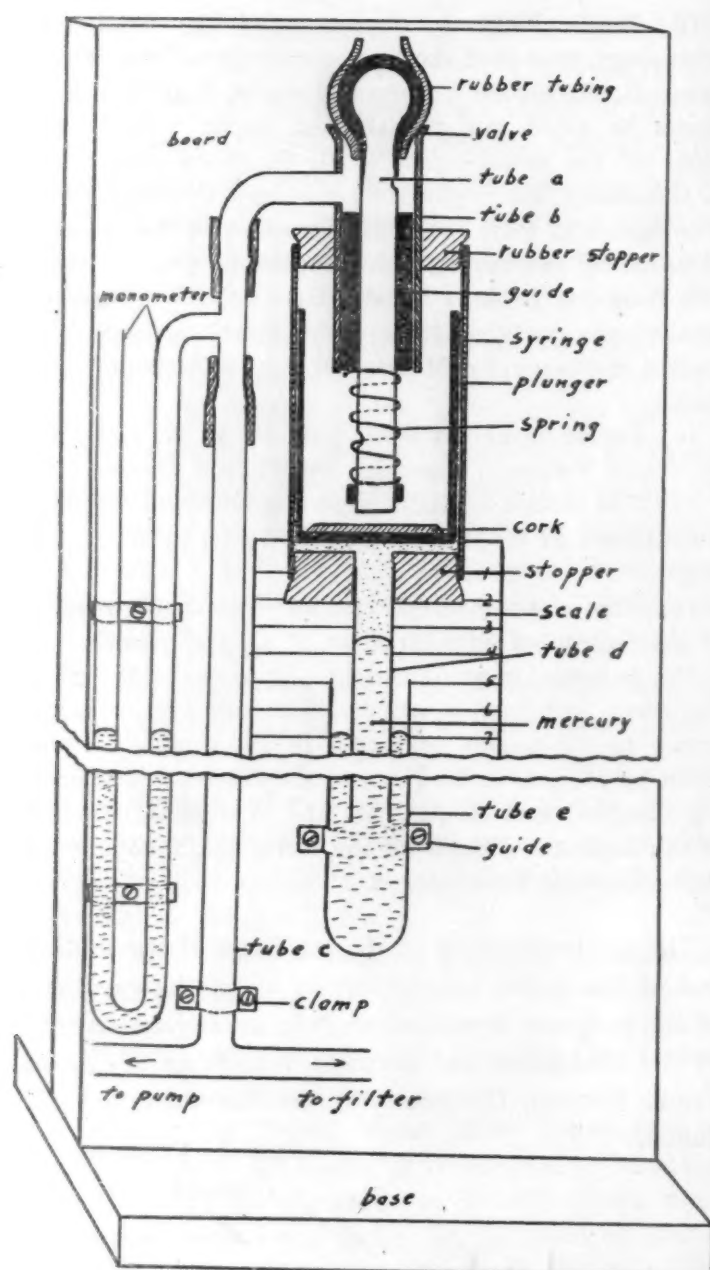


FIG. 1

over the lower end of tube *a* and held in place by a piece of rubber tubing, or any other convenient means. Into the lower end of the syringe is fitted a stopper with a glass tube *d*. This stopper should preferably be of some other material than rubber for the reason that oil will gradually cause the disintegration of rubber. A tight fitting cork stopper will do. Tube *d* should be 40 to 50 cm long depending upon the maximum filter pressure desired. An outer tube *e* is placed over tube *d*. Tube *e* should be about the same length as tube *d*. Tube *c* has on the end a T-tube one arm of which connects with the pump and the other arm with the filter. The apparatus is most conveniently mounted on a board about 10 cm wide and 80 cm to 100 cm tall. This board may be fitted with a base or screwed to a tall ring stand. The syringe and attachments may be clamped firmly to the board but tube *e* must be movable. It is best to have tube *e* in a guide, and also a clamp to hold it in any desired position. An open mercury manometer

should also be connected with the apparatus. This may be conveniently done as shown in the illustration.

When the apparatus is all made tube *e* is partially filled with mercury and a few cubic centimeters of oil is poured on top of the mercury which has risen in tube *d*. The quantity of oil should be sufficient to keep the level of the mercury in tube *d* always visible and below the stopper in the syringe. Tube *d* is now lowered into tube *e* until the oil is visible above the stopper. The syringe, with the plunger protruding slightly from the lower end, can now be fitted over the stopper on tube *d* so that little if any air is trapped inside the syringe between the plunger and the stopper. The top part may now be put in place and the apparatus is ready for use.

The principle upon which the regulator works is similar to that of a hydraulic press. As the pressure falls in the syringe the plunger is forced upwards and tube *a* is forced downwards. The forces on these two are proportional to the cross sectional areas of the plunger and of the valve. If the cross sectional area of the plunger is twice that of the valve the upward force on the plunger will be twice the downward force on tube *a*. If the mercury level in tube *d* is above that in tube *e* there will be a downward pull on the plunger proportional to this difference of levels. At equilibrium the downward force on tube *a* by the outer air and the spring is equal and opposite to the upward force on the plunger by the outer air minus the weight of the column of mercury between the levels in tubes *d* and *e*. When the upward force on the plunger becomes greater than the downward force on tube *a*, tube *a* is forced up and the valve is opened. Equilibrium is thus maintained by the opening and closing of the valve. It is obvious that the greater the difference in mercury levels in tubes *d* and *e* the lower the pressure in the syringe must be to attain equilibrium. It may also be seen that the difference in mercury levels in tubes *d* and *e* is a linear function of the pressure in the syringe. By moving tube *e* up or down the equilibrium pressure in the syringe may be made equal to any desired pressure. Behind tube *e* may be placed a scale which measures the difference of the mercury levels in tubes *d* and *e* but which is graduated to read the pressure in the syringe directly in centimeters of mercury. To make the scale the apparatus is first connected to an open mercury manometer as shown in Fig. 1. Place tube *d* at a certain level. When equilibrium is attained read the manometer and also the difference of the mercury levels in tubes *d* and *e*. Repeat by moving tube *e* to different levels. Plot the results. The points should fall on a straight line. If the points are not on a straight line there is some leak or the pump is incapable of producing the desired pressure. One such curve is shown in Fig. 2. The point at

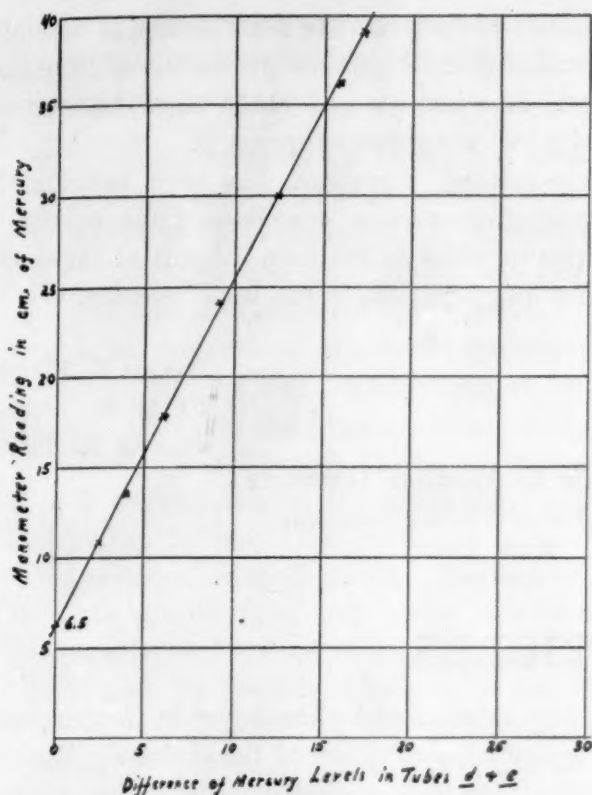


FIG. 2

which the curve crosses the ordinate represents the pressure to operate the spring. The stiffer the spring the greater this pressure will be and *vice versa*. The slope of the curve is equal to the ratio of the difference in levels of the mercury in the open manometer and in tubes *d* and *e*. In Fig. 2 it may be seen that if the difference of the mercury levels in tubes *d* and *e* is changed .55 cm that in the manometer is changed 1 cm. Therefore, if a scale is constructed with divisions equal to the slope of the curve (in this case .55 cm) but marked 1, 2, 3, etc. cm the scale will read the pressure in the system directly in centimeters of mercury. The scale is fastened behind tube *e* so that the level of the mercury in tube *d* (at equilibrium pressure in the syringe) is opposite to the pressure reading equal to that at which the curve crosses the ordinate axis, in this case 6.5 cm.

EINAR LEIFSON

THE JOHNS HOPKINS UNIVERSITY

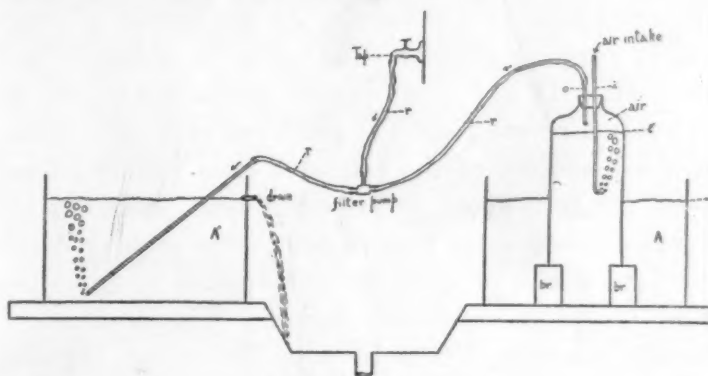
INEXPENSIVE AERATED AQUARIA

FOR several years the writer has been using an economical method of aerating aquaria suitable for high schools and institutions which can not afford the more expensive pressure systems used in the larger research laboratories.

The system of two aquaria (A and A'), as set up in the text figure, can be aerated efficiently at a low cost. The apparatus includes two aquaria, one bell jar (open top high form), one suction filter-pump, three pieces of glass tubing, three sections of rubber hose, one two-hole rubber stopper, and two half bricks.

It is necessary in aquarium A to place the bell jar on two pieces of brick in order to facilitate circulation of water currents. The glass tube (i) can be adjusted so that air will bubble continuously into the jar. In starting the apparatus it is necessary to have the lower end of tube (i) below the water surface (1). When the water level (1') within the jar almost reaches the lower end of the tube (o), the tube (i) should be raised above the water level (1). The suction from the outlet (o) creates a partial vacuum in the top of the jar. This causes the water in the bell jar to approximate a level which will tend to equalize the atmospheric pressure on the water inside and outside the jar. When these two pressures are equalized the water in the jar maintains a constant level and air will bubble intermittently in the water. This causes aeration and circulation of water sufficient for the whole aquarium.

The second aquarium A' can be used in cities where the water is not acid nor chlorinated, since the water passing into aquarium A' is tap water. This second system was devised and used by one of the Hertwig brothers in his German laboratory.



An aquarium of type A into which there were placed fifty-five bullfrog tadpoles, seventy-six crayfish and eight small minnows operated for six weeks with only one change of water and with a loss of only three crayfish and five tadpoles. Either fresh or salt water can be used in Aquarium A.

J. HENRY WALKER, JR.

UNIVERSITY OF ALABAMA

DIFFERENTIAL FILTRATION AS A MEANS OF ISOLATING BACTERIUM GRANULOSIS

It is often difficult to separate very small slowly growing from larger more rapidly growing bacteria. This is especially true in the attempts to obtain *Bacterium granulosis* in a pure growth from cultures of conjunctival suspensions.

Bacterium granulosis usually requires four or five days for a growth sufficient for ordinary transfer. By this time, contaminating organisms such as staphylococci and diphtheroids have been multiplying rapidly, making it difficult, and frequently impossible,

to recover *Bacterium granulosus* in pure culture by the usual methods of diluting and plating.

In order to overcome this difficulty we have attempted to separate the smaller from the larger organisms by means of differential filtration.

Berkefeld "V" filters, new or used, are selected and tested for permeability for *B. prodigiosus* and staphylococci. The filters which allow the passage of *B. prodigiosus* but not of staphylococci are chosen. A suspension of the contaminated material is diluted in normal saline solution and passed through the filter. The filtrate is either spread on plates or inoculated into leptospira medium. Occasionally other small bacteria may be found in the cultures of the filtrate along with *Bacterium granulosus*. These other organ-

isms have not offered the same technical difficulty of separation from *Bacterium granulosus* as have staphylococci, diphtheroids and other large bacteria which rapidly overgrow and suppress it.

This method, therefore, has been satisfactory in separating *Bacterium granulosus* from contaminated cultures in which it has been difficult or impossible to recover the organism in the usual manner.

RALPH E. KNUTT
PETER K. OLITSKY
JOSEPH R. TYLER

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH,
NEW YORK

SPECIAL ARTICLES

A RATION FOR THE PRODUCTION OF RICKETS IN CHICKS

Up to the present time we have used a ration consisting of 97 parts of ground yellow corn, 2 parts of calcium carbonate, 1 part of common salt, and skimmed milk *ad libitum* for the production of rickets in growing chicks. The ration is extremely low in vitamin D, and when day-old chicks are placed on the ration severe rickets is produced in 5 to 6 weeks. The ash content of the extracted tibia removed from these chicks is about 30 to 33 per cent., while the ash content of similarly treated tibia from normal White Leghorn chicks of the same age is about 40 to 45 per cent. or often somewhat higher. The addition of various sources of vitamin D to this ration, together with a study of the ash content of the bone, furnishes an excellent method for the determination of the vitamin D potency of these materials. However in the evaluation of sources of vitamin D, especially cod liver oils and other fish oils, for the poultry industry as well as for the scientific study of rickets in chicks, there has been a demand for a suitable dry ration. State inspection laboratories, looking forward to the control of marketable sources of vitamin D, find it inconvenient to use a ration containing liquid skimmed milk because of the difficulty of procuring skimmed milk daily. Another objection to the liquid skimmed milk ration is the variable intake that follows its use. Consequently we have, during the past two years, attempted to develop a suitable dry ration for the study of rickets in chicks. Dry rations have been used in several commercial laboratories and in institutions studying the problem of rickets in chicks; but it would seem advisable if the ration here proposed or some other equally suitable ration could be more generally adopted.

A ration to be satisfactory must be palatable, give good growth and in the presence of vitamin D contain

sufficient calcium and phosphorus in the proper ratio for optimum calcification of the skeleton. We believe, too, that the ration should be one that gives pronounced rickets in 4 to 5 weeks—in fact, may lead to a high mortality at that age. The chick itself is particularly suitable for studies of bone development because of its wonderful sensitiveness to the absence of vitamin D. One does not need a one-sided ration, that is, high calcium and low phosphorus, or high phosphorus and low calcium, to produce rickets in the chick as has been commonly used in the production of rickets in the rat. In the case of the chick severe rickets is readily produced where the calcium and phosphorus content of the ration is at a reasonable level, and with an optimum ratio, such as 2 parts of calcium to 1 part of phosphorus.

It is true with the chick, as with other animals, that the mineralization of the bones can be influenced by the level and ratio of calcium and phosphorus in the ration. With the use of what is known as the Wisconsin baby chick ration, in which the calcium and phosphorus are particularly high, that is, approximately 2.5 per cent. of calcium and .7 per cent. of phosphorus, rickets is delayed in the absence of vitamin D and fair mineralization of the bones results during the early growing period. On the other hand, in the ration that we are suggesting for a standard rachitic ration with chicks, the calcium and phosphorus are sufficiently high to give excellent calcification where vitamin D is adequately supplied, but a very distinct picture of rickets in the absence of vitamin D. The ration that we have finally adopted is one consisting of:

59 parts of ground yellow corn
25 parts of wheat middlings (standard)
12 parts of crude casein
1 part of common salt

- 1 part of precipitated calcium carbonate
- 1 part of precipitated calcium phosphate
- 1 part dried yeast¹

This ration contains from 19 to 20 per cent. of protein, .9 to 1 per cent. of calcium, and .5 to .6 per cent. of phosphorus. It is composed of materials that are readily obtainable for any laboratory and of standard materials available on the market. The yeast was added because of the better growth that was obtained through its use. White Leghorn chicks started on this ration in the presence of an adequate supply of vitamin D will weigh 300 to 325 grams at the end of 6 weeks; without the yeast they will be 50 to 100 grams lighter. We preferred to have a ration that gave good rates of growth. Day-old White Leghorn chicks placed upon this ration will become distinctly rachitic in from 28 to 35 days, and some of the birds may be dead by the end of the fifth week, with an ash content of the extracted tibia approximating 30 per cent. In the presence of an adequate supply of vitamin D, White Leghorn chicks fed this experimental ration for 35 days will weigh about 225 grams, and the ash content of the extracted tibia will generally be 43+ per cent.

Our technique in conducting the experiment is as follows: White Leghorn chicks, one-day old and weighing 30 to 35 grams, are placed in groups of 6 or 8 in warmed hovers provided with screen bottoms. These screen bottoms are made of wire mesh, either two or three mesh to the inch, and used for the purpose of minimizing excreta consumption. Shavings are placed under this false screen bottom. The birds are fed water only for the first day; but on the second day they are given small portions of the ration upon a cardboard mat. On the third day the ration is placed in suitable feeders and so continued during the 5 weeks of the experiment. If consumption records are desired the birds can be placed in individual cages and fed through suitable grids, whereby accurate consumption records can be obtained. The birds are weighed weekly. At the end of the fifth week they are killed, the tibiae removed and placed in 95 per cent. alcohol until convenient to proceed with the analysis. They are then crushed, individually wrapped in filter-paper, and extracted for 72 hours with hot 95 per cent. alcohol. Finally the bones are dried, weighed, and ashed in an electric muffle furnace for 1 hour at a cherry red heat (about 650° C.). The percentage of ash is used as the index for estimating the degree of calcification.

The curative type of experiment and the "line test" as used in the case of the rat are not possible in the

case of the chick. In the healing of rickets in the chick there is no distinct line of calcification, but healing is diaphyseal and immediately contiguous with the trabeculae that remain after rickets is produced. Consequently no distinctive "line" is formed during healing.

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O. L. KLINE
J. A. KEENAN

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UNIVERSITY OF WISCONSIN

AN INVESTIGATION OF "INSIGHT" IN RATS

IN some preliminary experiments conducted recently the writer sought to get further evidence on the existence of "insight" in rats.

The problem was formulated as follows: If rats have learned to take a difficult path to food in preference to an easy but blocked path, and if then the easy path is offered as a short cut to food, what type of reactions will occur? According to a mechanistic theory of learning the rats should continue to take the difficult path even if the easy path has been so arranged as to lead to food under the most favorable conditions. On the other hand according to theories which oppose the simple mechanistic formulations, one might expect the operation of "insight" as indicated by an immediate or rapid switch to the easier path.

The experimental setting designed to meet the conditions of the problem was as follows: An elevated, open maze was used.¹ (See Fig. 1.) The easy path W was an open running path blocked at B near the

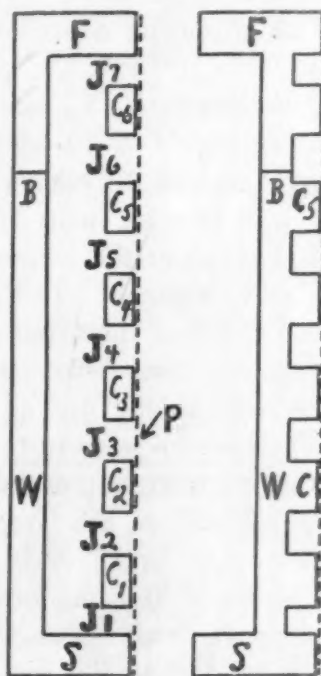


FIG. 1

FIG. 2

¹ The yeast was obtained from the Northwestern Yeast Company, Chicago, Illinois. Experimental yeast (powdered yeast foam tablets) with 50 per cent. + of protein).

¹ W. R. Miles, "The Narrow Path Elevated Maze," *Proc. Soc. Exp. Biol. and Med.*, 24: 454-456, 1927.

food box F. This was separated in the initial learning from the true but difficult path C which consisted of a series of jumps from one platform to another. After the rats had learned to take the C pathway to food, the running path W was moved over until it touched the series of C platforms. In this test situation (See Fig. 2) rats therefore had the opportunity to run along W to the block and so on to the fifth platform of C, thus eliminating most of the difficult jumps along the C pathway.

If rats in such a test situation as described above should continue to take the difficult jumping path to food, their behavior could be explained by mechanistic theories of learning. If, however, they should suddenly and immediately choose the easy, running pathway, their behavior could not be so explained. Such behavior would support the striking evidence of Tolman and Honzik² that rats are able suddenly to go against previous habit and preference. In the present experiment all rats continued to jump in the test situation and the results therefore tend to agree with a mechanistic explanation of learning.

However, before presenting the results in greater detail, the dimensions of the maze, length of jumps and amount of preliminary training are necessary factors to be considered. Path W was 6 in. wide, 15 ft. long and was blocked at B 11 ft. 6 in. from S, the starting platform. The platforms C₁, C₂, etc., of the C pathway, were 20 in. long, 6 in. wide, and were tipped with rubber on the landing end and screen wire on the jumping end, the latter tips enabling rats to get a good foothold for the jump. The platforms and jumps along C were bordered by a wall, indicated in the figures by the dotted line P. Paths W and C were separated 12 in. during a preliminary training period.

The length of the jumps J₁, J₂, etc., was increased during the training period of 70 trials until on the 70th trial jumps 1, 5 and 6 equalled 10 in., jumps 2 and 4 equalled 16 in. and jump 7 equalled 4 in. Observations of behavior at the jumps indicated that they were made with reluctance. In the last 10 trials of the training all rats took the C pathway in preference to W. They were then tested on the 71st trial.

Results summarized briefly are as follows: Rats (N equals 7) continued to jump in the test situation for from 10 to 20 trials after the paths were moved together. The elimination of the jumps was gradual. Even after full runs along W to B had once been made, all rats persisted in many of the succeeding trials in jumping part or all of the way to platform C₅. This was done despite the fact that complete runs along the short cut W to B and thence to food

by C₅ and C₆ averaged 10 seconds, while the average time along the C path was 30 seconds. A final preference for the short cut W was established and thereafter rats never took the C path, except beyond B. There was no indication that any rats "saw" into the short cut W in the test situation.

The experiment is being continued. The writer is planning to use the method as a means of analysis of habit fixation by putting path W adjacent to path C at various stages of training; by introducing in the test a new path, different from W; and by allowing path W to be a true path to food in part of the training period.

Since one interpretation of the results described above might be that running and jumping constitute separate abilities, and therefore are too different to permit a sudden change in habit, it is intended to run a comparison series in which path C consists of a running path containing a number of *cul de sacs*. At the test the two running paths will then be placed together.

Apart from the bearing of the results of this experiment on theories of learning, it would appear that the jumping activity itself should be of interest to comparative psychologists. Lashley³ recently reported a series of discrimination experiments in which rats were required to jump, but, with the exception of the present work, the writer knows of no attempt to apply jumping to a maze situation. The contrast between running and jumping in the same rats yields sharp, objective differences in behavior and, where such sharp contrasts are needed, the activity should be valuable. It could probably be used as a substitute for some of the "obstruction" methods now in use by extending the jumps beyond the distances used here. It is likely that applications of the activity to other problems might readily be made.

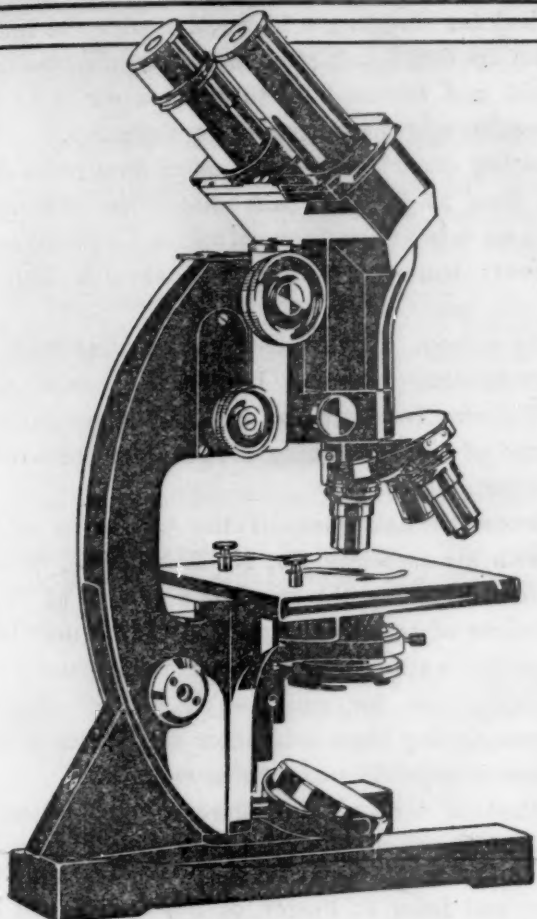
H. C. GILHOUSEN

HARVARD UNIVERSITY

BOOKS RECEIVED

- BIRD, CHARLES. *Effective Study Habits*. Pp. xv + 247. Century. \$1.50.
- BURRELL, ROBIN C. *Chemistry for Students of Agriculture and Home Economics*. Pp. xviii + 459. 75 figures. McGraw-Hill. \$3.50.
- CURTIS, FRANCIS D. *Second Digest of Investigations in the Teaching of Science*. Pp. xx + 424. Blakiston. \$3.00.
- HAMILTON, L. F. and S. G. SIMPSON, editors. *An Introductory Course of Quantitative Chemical Analysis*, by Henry P. Talbot. Seventh edition, revised. Pp. xii + 253. 8 figures. Macmillan. \$2.50.
- KIRKPATRICK, T. BRUCE and ALFRED F. HUETTNER. *Fundamentals of Health*. Pp. ix + 576. 100 figures. Ginn. \$3.80.
- NORRIS, JAMES F. *Principles of Organic Chemistry*. Third edition. Pp. xi + 595. McGraw-Hill. \$3.00.
- ³ K. S. Lashley, "The Mechanism of Vision," *Jour. Genet. Psychol.*, 37: 453-460, 1930.

² E. C. Tolman and C. H. Honzik, "Insight in Rats," *Univ. Calif. Publ. Psychol.*, 4: 215-232, 1930.



GSET is destined to make many friends

THE tilted binocular body of Bausch & Lomb's new GSET Microscope contributes greatly to the comfort and convenience of the microscopist. Being binocular, it relieves eyestrain, and the inclination allows you to work with the stage in a horizontal position without tiring the neck muscles. Also the new heavy stand gives

stability, yet it can be moved about with ease. Maximum space is provided for manipulation of specimens.

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME ADVANCES IN THE PHYSICAL SCIENCES DURING 1930

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A NEW physical concept, the paradoxical one that two separate particles of matter can be completely identical, was enunciated by Professor Gilbert N. Lewis, of the University of California.

That space is not empty but filled with electrons of minus or negative energy, was suggested by Dr. P. A. M. Dirac, of the University of Cambridge, England.

A new theory of the universe, assuming that it is non-static and consisting of matter dissipating through radiation, was propounded by Dr. Richard C. Tolman, of the California Institute of Technology.

The possibility that the whole universe is fading away so that in some timeless future no matter will remain, only radiation, was indicated by calculations made by Dr. Louis S. Kassel, of California Institute of Technology.

The theory that cosmic rays are not rays at all but high velocity particles was advanced by two German physicists, Dr. Walter Bothe, of Berlin, and Dr. Werner Kolhoerster, of Potsdam, as a result of experiments they have conducted with a specially built adaptation of the electron counter, but researches of Dr. R. A. Millikan on the intensity of cosmic rays near the north magnetic pole provide evidence against the theory.

The theory that cosmic rays consist of high-velocity particles, like tiny bullets, was supported by experiments conducted by Dr. L. F. Curtiss, of the U. S. Bureau of Standards, in which he used two electron counters.

A clock which will set itself in response to radio-time signals was developed by H. C. Roters and H. L. Paulding, of the Stevens Institute of Technology.

A new type of clock controlled electrically by a vibrating crystal, thus dispensing with a pendulum, has been developed under the direction of Dr. W. A. Mar-
rison, of the Bell Telephone Laboratories.

A moulded compound, including silicon carbide or carborundum, which has the quality of preventing the flow of electricity at low voltages while allowing it to pass at high potentials, was developed at the laboratories of the General Electric Company.

The method by which the diameters of stars have been measured through the interference of light waves was applied to the extremely accurate measurement of terrestrial distances in an instrument developed by Stuart H. Chamberlain, of Michigan State College.

A device for measuring the intensity of ultra-violet rays by means of an ultra-violet-sensitive photoelectric cell connected with a condenser, which as it discharges operates a counter, was developed in the research laboratories of the Westinghouse Lamp Co.

A film phonograph capable of playing for two hours from a 400-foot reel of motion picture sound film was perfected by Dr. C. H. Hewlett, engineer of the General Electric Company.

A method for stopping a locomotive with the reflected light from its own headlights caught on mirrors on the signal post and focussed by them on a series of light-sensitive cells was demonstrated in Germany.

Alternating electric current is more dangerous at low voltages than at high, it was discovered through experiments on rats at the Johns Hopkins University: with the ordinary house potential of 110 volts, 100 milliamperes will cause death.

Electric current direct from sunlight was made possible through the invention by Dr. B. Lange, of the Kaiser Wilhelm Institute for Silicate Investigation, of a new type of cell containing copper oxide between two layers of metallic copper.

Dr. Ernest O. Lawrence, of the University of California, with his associate, Dr. N. E. Edlefsen, devised a method for increasing the speed and energy of the protons or hearts of hydrogen atoms, so that it may be possible when the method is further perfected to use them as atomic projectiles for smashing the hearts of other atoms, transmuting them into other substances or releasing enormous quantities of atomic energy.

A method of taking photomicrographs by long-wave ultra-violet light through an ordinary glass lens, was discovered by Dr. A. P. H. Trivelpiece, of the Eastman Kodak Company, and Leon V. Foster, of the Bausch and Lomb Optical Company.

The final value for the most accurate measurement ever made of the constant of gravitation was announced after seven years' work by Dr. Paul Heyl, physicist of the U. S. Bureau of Standards, to be the fraction 6.670 over 100,000,000.

Artificial gamma rays, which may take the place of radium in the treatment of cancer, are produced by a giant vacuum tube operating at 700,000 volts, at the California Institute of Technology.

An electric photoflash lamp, a German invention, for taking flashlight photographs without noise or smoke was introduced in the United States, the light being made by aluminum foil ignited electrically in a bulb full of oxygen.

Chemistry

The existence of rotating molecules in solid compounds was reported by Professor Linus Pauling, of the California Institute of Technology, and Dr. Sterling B. Hendricks, of the Fixed Nitrogen Laboratory, U. S. Department of Agriculture. This discovery has an important bearing on the heat capacities of solids.

The magnetic susceptibility of samarium sulphate octohydrate was announced by Dr. Simon Freed, of the University of California, arousing great interest among chemists because the discovery indicates the possibility of electronic isomers in the solid state.

The chemical puzzle of the structure of the crystal of the silicates was solved by Professor William L. Bragg, Victoria University of Manchester, England, and Profes-

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Vol. III: The vegetation of Mt. Desert Island, Maine, and its environment. By Barrington Moore and Norman Taylor. 151 pp., 27 text-figs., vegetation map in colors. June 10, 1927. Price, \$1.60.

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sor Linus Pauling, of the California Institute of Technology.

A new gas for use in electric refrigerators, non-poisonous and non-inflammable, which is a compound of carbon, chlorine and fluorine, was the invention of Mr. Thomas Midgley, Jr.

That carotin, which makes some foods yellow, is important for nutrition as well as the green chlorophyll, because vitamin A is associated with this color in vegetables, butter, and egg yolk, was discovered by S. M. Hauge and J. F. Trost, of the Purdue University Agricultural Experiment Station.

Bacteria obtained from brewer's malt may now be pressed into the service of the chemist to eat away the cell walls of plant tissue and liberate the vegetable oil, according to a method developed by John Woods Beckman, industrial chemist, of Oakland, California.

A device for removing carbon monoxide from the exhaust gases of an automobile by means of a catalyst was demonstrated by the inventor, Dr. J. C. W. Frazer, of the Johns Hopkins University.

The richest source of helium yet discovered, a natural gas in southeastern Colorado containing seven per cent. of helium, was reported by F. F. Hintze, of the University of Utah.

Crystals of rubber were obtained for the first time in the chemical laboratories of the U. S. Bureau of Standards.

The U. S. Pharmacopoeial Convention, which meets once in ten years to decide on the contents of the Pharmacopoeia or standard for drugs and chemicals, met in Washington in May.

Astronomy

A new planet, the first to be discovered since 1845, was found photographically with a 13-inch telescope at Lowell Observatory in approximately the place predicted by the late Professor Percival Lowell, founder of the observatory, who died in 1916. The planet, which is farther from the sun than any other yet discovered, was later named Pluto.

That inter-stellar space, especially in the plane of the Milky Way, is not transparent, but filled with diffuse material that absorbs a considerable amount of light from distant stars, thus making the previous estimates of their distances too large, was indicated by researches of Dr. R. J. Trumpler, of the Lick Observatory, supported by independent work of Dr. Piet van de Kamp, of the Leander McCormick Observatory.

A faint group nebulae was found to be apparently speeding away from the earth at the rate of 7,200 miles a second, the highest astronomical speed yet recorded, by studies of Dr. Edwin P. Hubble and Milton L. Humason, of Mt. Wilson Observatory, but it is supposed that the effect is really an illusion, due to curvature of space.

The eccentric little planet Eros, which aids astronomers in determining the earth's gravitational power and the sun's distance, approached closer to the earth than it has at any time since its discovery in 1896.

That many stars are spinning at the rate of 40 miles

a second, 150 times the speed of the earth at the equator, was discovered by a new method developed by Dr. Otto Struve, of the Yerkes Observatory, in collaboration with a Russian astronomer, Dr. G. Shajn.

An unusually large display of Leonid meteors was visible on the early morning of November 17, suggesting the possibility of a brilliant shower in November, 1932, 1933 or 1934.

Long-range forecasting of weather may be made possible through the discovery by Dr. C. G. Abbot, secretary of the Smithsonian Institution, that there is a close correspondence between changes in the sun's radiation and in temperature at Washington, D. C.

The theory that stars have a structure similar to that of an egg, a dense yolk in the center, surrounded by a lighter material, was advanced by Professor E. A. Milne, of the University of Oxford.

A new theory of the construction of the universe, that it constitutes a huge system made by the condensation of a loose swarm of smaller clusters of stars which were originally like the mysterious spiral nebulae, was proposed by Dr. Harlow Shapley, director of the Harvard College Observatory.

That Halley's comet had two distinct tails was concluded by Dr. N. T. Bobrovnikoff, of the University of California, after three years of intensive study of 700 photographs taken of the comet in 1910.

The surface of the moon is apparently covered with volcanic ash, according to researches conducted by Dr. B. Lyot, of the Paris Observatory.

The theory that the earth may have a comet-like tail sometimes visible as a faint patch of light called by astronomers the "Gegenschein," was advanced by Dr. E. O. Hulburt, of the U. S. Naval Research Laboratory.

On April 28, the United States saw its first total eclipse of the sun since 1925 when the shadow of the moon just touched the earth on a path which passed through California, Nevada, Idaho and Montana.

A total eclipse of the sun, on October 21, was witnessed by two parties of astronomers from tiny Niuafoou Island in the Pacific.

The length of Neptune's day was found by Dr. J. H. Moore, of the Lick Observatory, to be about 16 hours.

A new 50-foot interferometer, a giant instrument for the measurement of the diameter of stars through the interference of reflected light waves, was completed at Mount Wilson Observatory in California.

That arsenic and germanium are both present in some meteorites that fall to the earth was discovered by Dr. Jacob Papish and Zaida M. Hanford, Cornell University chemists.

On November 15, 1930, astronomers commemorated the three-hundredth anniversary of the death of Johann Kepler, the great German astronomer who first enunciated the laws of planetary motion.

America's first planetarium in which the observer may at will see a facsimile of the heavens as they look at any time and from any place, was opened on May 10 at Chicago.

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sun-spots, solar radiation constant and data on magnetic disturbances, was inaugurated by *Science Service* with the cooperation of the International Scientific Radio Union.

The discovery of seven comets was announced during the year, though one was not confirmed and another was a return of a periodic visitor. The first and fourth were discovered by Drs. Schwassman and Wachmann, of the Hamburg Observatory, Germany, though the former was independently found by L. C. Peltier, an amateur astronomer of Delphos, Ohio. The second was discovered by Beyer, also at Hamburg; the third by Wilk, of Cracow, Poland; the fifth by D. L. Forbes, of Rondebosch, South Africa; the sixth was the re-discovery of Temple's second comet by Dr. George Van Biesbroeck, of the Yerkes Observatory, and the seventh was by Nakamura, of the Kyoto Imperial University, in Japan. Efforts of American astronomers to find Nakamura's comet, which Japanese dispatches said had been observed by Sibata, of the same observatory, were unsuccessful, however.

Engineering

After a third attempt, Professor Georges Claude was successful in obtaining power from the temperature difference in the ocean water at the surface and in the depths of the tropical seas off the Cuban coast.

The two longest steel arches in the world were closed—the Kill Van Kull Bridge at New York with a 1,675-ft. span and the Sidney Harbor Bridge, Australia, 1,650-ft.

An elevated monorailway 30 miles long carrying a propeller-driven car which travels 120 miles per hour was completed near Glasgow, Scotland.

Application of the hydrogen-ion of crude oil, which greatly increases the production of gasoline, was extended.

The city gas business was further invaded by natural gas and its by-products, propane and butane, and petroleum refinery gas; natural gas being piped as far as 1,000 miles to centers of population.

Construction progressed on the world's largest hydroelectric power plant, the Dneprostroy project in Russia, which will have an ultimate capacity of 750,000 hp., and on the largest hydro-generators, 77,500 kilovolt-ampere capacity, and turbines, 84,000 hp. capacity.

Final work was done on the new Welland Canal, a mammoth structure built by Canada to pass sea-going lake grain vessels up and down the 326.5-foot difference in elevation between Lake Erie and Lake Ontario.

Plans were made and bonds authorized for the \$35,000,000 Golden Gate Bridge at San Francisco, the center suspension span of which will be 4,200 feet, the longest in the world.

U. S. Department of Interior began preliminary field work on the construction of the 730-foot Hoover Dam, world's highest, a part of the Boulder Canyon project on the Colorado River.

The Detroit-Windsor vehicular tunnel, connecting Canada and the United States beneath the Detroit River, was opened to traffic.

An experimental boiler designed to operate at pressures ranging from 3,500 to 4,500 pounds per square inch and a temperature of 833 degrees Fahrenheit was built.

A severely stream-lined railway car driven by a 400 hp. airplane engine and propeller sped more than 100 miles per hour on a straight track in Germany.

Construction progressed on the Ft. Lee 3,500-ft. span suspension bridge across the Hudson River at New York and the 1,500-ft. Mid-Hudson suspension span at Poughkeepsie.

The application of welding to steel building was greatly extended, the number of such buildings being increased 50 per cent.

The world's longest concrete arch bridge was built at Brest, France, with three spans, each of 612 feet.

The *Europa*, new German ocean liner, entered service and became speed queen of the North Atlantic by bettering the record of her sister ship, the *Bremen*.

The U. S. Bureau of Standards prepared for the construction of a National Hydraulic Laboratory provided for by Congress at a cost of \$350,000.

Coolidge Dam across the Gila River canyon near Globe, Ariz., a dam of unusual construction making use of multiple domes, was dedicated by the ex-president for whom it was named.

The fiftieth anniversary celebration of the American Society of Mechanical Engineers was held.

The first roller-bearing locomotive was built and put in service.

The Keenan Steam Tables and Mollier Diagram, which for the first time tabulate and graphically present the properties of steam at the higher temperatures and pressures at which it is now being used in large power plants, was published by the American Society of Mechanical Engineers.

Chicago's Merchandise Mart, said to be the largest building in the world, was completed.

The U. S. Patent Office issued 49,599 patents and accepted 117,790 applications during the fiscal year ending in June.

Construction advanced on the world's largest high-pressure turbine-generator, a 110,000 kilowatt steeple compound unit to operate at 1,200 pounds per square inch pressure in the River Rouge power plant near Detroit.

The highest boiler pressure ever used in America, 1,800 pounds per square inch, was employed in a 6,000 kilowatt power plant nearing completion at Lockland, Ohio.

The highest bridge in the world, carrying a highway 1,260 feet above the Arkansas River, was completed over the Royal Gorge near Canon City, Colorado.

A radio telephone service was installed between New York and Buenos Aires, making possible the connection by radio phone of four continents—North America, South America, Europe and Africa.

The first completely welded ocean-going cargo vessel was launched at Charleston, S. C.

The world's first floating power plant, the *S. S. Jacona*, with a generating capacity of 20,000 kilowatts, was placed in service along the New England coast as a source of emergency power.

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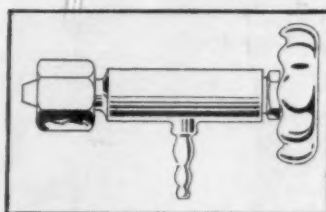
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SCIENCE NEWS

*Science Service, Washington, D. C.*SOME ADVANCES IN THE SCIENCES
DURING 1930*(Continued from the issue of January 2)**Copyright, 1930, by Science Service**Biology*

QUARANTINE restrictions on Florida fruit and vegetable shipments, designed to prevent the spreading of the Mediterranean fruit fly, were wholly removed on November 15.

The plant breeder who originates a new variety of plant propagated by asexual or vegetative means was given, by act of Congress, the right to a patent of his living product.

The world's largest fish hatchery was completed near Lonoke, Arkansas, for the propagation of the warm-water nest-building fishes, such as bass and bream.

A new instrument, a modification of the interferometer, was devised by Professor K. W. Meissner, of Frankfurt, Germany, making it possible for the first time to see a plant grow.

A swarm of locusts appeared across northern Africa, from Egypt almost to Gibraltar, and extended into the Near East and Balkans.

That the fungus of black-stem rust is capable of producing hybrids and thus multiplying the strains which attack wheat, was discovered by Dr. J. H. Craigie, of the Dominion Experimental Farms at Winnipeg.

Two sets of human identical triplets were reported by Alfred E. Clarke and Daniel G. Revell, biologists of the University of Alberta, Canada.

Animals can manufacture the growth-promoting vitamin A in their bodies from carotin, it was found by Dr. Thomas Moore, Cambridge, England.

A herd of 30 musk-oxen was transplanted from Greenland to Alaska by the U. S. Department of Agriculture in an effort to re-establish them in the latter country.

Dr. J. Markowitz and Dr. H. E. Essex, of the Mayo Foundation, were successful in keeping alive the internal organs of an animal for 12 hours after the animal had died.

Man lowered himself farther into the ocean depths than ever before when William Beebe and Otis Barton descended 1,426 feet in a steel sphere off the coast of Bermuda.

Geology and Geography

The decennial census of the United States was made, showing the population to be 122,775,046.

The most severe drought and hot season recorded by the Weather Bureau gripped practically the whole of the United States from June until mid-autumn, causing

severe damage to crops and range lands and bringing new records for low water in the rivers.

An extremely heavy rain visited France in which over 3,000 tons of water crashed down on each acre, and a rainfall equal to the normal annual average of 30 inches fell in two days.

A landslide destroyed part of the city of Lyons in France, taking many lives and destroying much property.

The largest meteoric stone whose fall was observed and which has been recovered intact, an 820-pound meteorite, fell near Paragould, Arkansas.

Great deposits of fossil mammal and bird bones were found in Wyoming.

Professor Wilhelm Freudenberg found in Ice-Age gravels near Heidelberg fragments of skull, face-bones, jaw and shoulder-blade of a big ape-like creature with a brain larger than that of any known anthropoid ape and equal in size to that of the Neanderthal man.

The fossil remains of a species of ape previously unknown were dug up in southern France.

Fossils of a redwood species were discovered on St. Lawrence Island in Bering Straits, bridging the gap between previously known occurrences in Asia and North America.

Huge deposits laid down in pre-Cambrian times were found in the Grand Canyon of Arizona.

The Polish Academy of Science announced the discovery of the complete body of an Ice-Age rhinoceros, with muscles and skin complete and in place, in the frozen soil of the district of Starunia, Poland.

The bodies of S. A. Andrée, pioneer aerial explorer of the Arctic, and his two companions were found, with Andrée's diary and other important historic documents, on White Island, Fridtjof Nansen Land.

A small airship was used by a party of U. S. National Park Service officials and scientists in a survey of an area in the southern Everglades which is to become a National Park.

The rebuilding of a submarine was begun for use by an Arctic expedition planned by Sir Hubert Wilkins.

Seismological reports of 29 earthquakes were collected and epicenters located by *Science Service* with the cooperation of the U. S. Coast and Geodetic Survey and the Jesuit Seismological Association; these included 15 violent shocks, six of which were destructive, on land in Italy, Japan, India, Persia, Guatemala and Chile.

Medicine

A hormone from the cortex of the suprarenal glands was isolated by Drs. W. W. Swingle and J. J. Piffner, of Princeton University, and used by Drs. Leonard G. Rowntree and C. H. Greene, of the Mayo Clinic, to treat hopeless victims of Addison's disease, in the same way that insulin affects the coma of diabetes. Drs. F. A.

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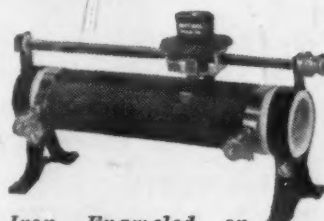
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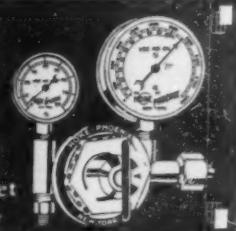
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Hartman and K. A. Brownell, of the University of Buffalo, also obtained an extract of the same gland.

The filterable virus germ which causes multiple sclerosis, or "creeping paralysis," was discovered with the aid of a special ultramicroscope at a magnification of 1,800 diameters by Sir James Purves-Stewart and Kathleen Chevassut, of the Westminster Hospital, London.

An artificial lung or respirator was invented by Drs. Philip Drinker and L. A. Shaw, of the Harvard School of Public Health, to keep alive patients whose breathing muscles are paralyzed in infantile paralysis or who are victims of gas poisoning.

A new method for studying the microscopic growth of living tissue in a warm-blooded animal was developed at the University of Pennsylvania School of Medicine.

An enzyme which has both protective and curative action on Type III pneumonia in mice, and possibly also in man, was extracted from a bacillus found in the soil of New Jersey cranberry bogs.

Vitamins in sufficient amounts will prevent infection of animals, and possibly man, with leprosy, it was reported by Dr. J. Shiga, dean of the Imperial Medical Faculty, Seoul, Korea.

Fever produced by short radio waves was found helpful in the treatment of paresis by Professor W. T. Richards, of Princeton.

The National Institute of Health was created by act of the Congress replacing the Hygienic Laboratory of the U. S. Public Health Service.

A new species of the meningococcus organism, cause of meningitis, was found by investigators of the U. S. Public Health Service.

Cancer studies were reported by numerous investigators. Drs. Walter B. Coffey and John B. Humber, of San Francisco, announced a method of treating cancer by injection of a glandular extract. Drs. Shigemitsu Itami and Ellice McDonald, of the University of Pennsylvania, reported they were unable to cure cancer in mice by this method. Dr. Frederick S. Hammett, of Philadelphia, found that the application of partly oxidized sulfur compounds caused tumors in mice to disappear.

Postgraduate demonstrations of cancer, in which radiologists, pathologists and other specialists tested and increased their diagnostic ability, were held under the auspices of the Surgical Pathological Laboratory of the Johns Hopkins University.

Experiments proving that the common cold is caused by a filterable virus were reported by two groups of investigators: Dr. Gerald S. Shibley, Katherine C. Mills and Dr. A. R. Dochez, of the Columbia University College of Physicians and Surgeons and the Presbyterian Hospital of New York; and Drs. Perrin H. Long and James A. Doull, of the Johns Hopkins Medical School.

An extensive outbreak of psittacosis, popularly known as parrot fever, occurred in the United States and many other countries. In this country 169 cases with 33 deaths were reported. Investigators of the U. S. Na-

tional Institute of Health made an extensive study but did not find the *Bacillus psittacosis* which a French scientist, E. Nocard, had reported as the causative germ in 1892. They concluded that the disease was caused by a filterable virus. They did find an organism which might be the cause of the disease, but it was not *B. psittacosis* or any other member of that germ family.

A phenol compound, tri-ortho cresyl phosphate was found by the U. S. Public Health Service to be the adulterant which caused thousands of cases of partial paralysis from drinking bootleg Jamaica ginger, known as "ginger Jake."

A new chemical method of standardizing ergot, widely used in childbirth, was devised by Dr. M. I. Smith, of the National Institute of Health, formerly the U. S. Hygienic Laboratory.

A large increase in the number of cases of infantile paralysis, almost reaching epidemic proportions, occurred during the fall of 1930.

An occupational disease causing an involuntary to and fro shifting of the eyes was found among train dispatchers by the Industrial Health Conservancy Laboratories of Cincinnati.

The time required for blood to clot, vitally important in surgical operations, is shortened by feeding the patient vitamin D.

Study of the chemical changes taking place in the brain was made possible for the first time through a technical procedure developed by Dr. Abraham Myerson, of Boston, whereby blood is taken from the artery leading to the brain and from the vein which drains the brain and the chemical contents of the two samples compared.

New hope for recovery of child victims of serious burns was given by a treatment, making use of a tannic acid solution, devised by Dr. Edward C. Davidson, of Detroit.

That radio waves, shorter than those commonly used for sending messages, are able to weaken materially the poison elaborated by the diphtheria bacillus was discovered by Drs. Wacław T. Szymanowski and Robert Alan Hicks, of the Western Pennsylvania Hospital Institute of Pathology.

A new method for measuring the heart's output of blood determining the amount of acetylene gas taken up by the lungs in a certain time was devised by Dr. Arthur Grollman, of the Johns Hopkins University.

An international birthday party, with the celebrations round the world united by radio, was given in honor of the eightieth birthday on April 8 of the "dean of American medicine," Dr. William Henry Welch.

The three hundredth anniversary of the first use of cinchona bark, from which quinine is obtained for the treatment of malaria, was celebrated.

To study the problems of the American child, scientists from all over the country at call of President Hoover met in a White House Conference on Child

SCHOOL AND SOCIETY

EDITED BY J. McKEEN CATTELL

CONTENTS

DECEMBER 13

Statistics of Registration in American Universities and Colleges: RAYMOND WALTERS

Educational Events:

Educational Tours to Europe; Inter-American Institute of Intellectual Cooperation; Recommendations of the White House Conference on Children's Libraries; The Annual Meeting of the American Association of University Professors; The Association of Colleges and Secondary Schools of the Middle States and Maryland; The University of Wisconsin and the Foundations; In Memory of William Barton Rogers

Educational Notes and News

Discussion:

Virgil Bimillennium Celebrated Prematurely: WALTER CROSBY EELLS. *Research in the Payment of School Executives:* QUINTUS H. FLACCUS

Special Correspondence:

Independent Work for Freshmen: PAUL P. BOYD
The Alumni University: THOMAS DIAMOND

Quotations:

Character Education

Reports:

Philadelphia Schools: SAMUEL P. ABELOW

Educational Research and Statistics:

An Investigation of the Success of the Indiana High-school Graduates in Indiana Higher Institutions of Education: JOHN M. STALNAKER. *Reliability of Vocational Choices of High-school Students:* WARREN W. COXE

DECEMBER 20

A Vision of the Future in Vocational Education: DAVID SNEDDEN

Educational Events:

Higher Education of the Deaf in Great Britain; Appropriations for Vocational Education in Porto Rico; Education in Alaska; Awards by the American Council of Learned Societies; Self-supporting Students at Yale University; Eleventh Annual Ohio State Educational Conference; Lectures on Applied Psychology; Appointment of Rhodes Scholars

Educational Notes and News

Discussion:

The Employment of Teachers: WILLIAM C. BAGLEY.
Football Success and College Enrolment: GEORGE W. GORRELL

Quotations:

Who's Who and the Colleges

Reports:

Education under the Department of the Interior Societies and Meetings:

Atlanta Meeting of the Association of Colleges and Secondary Schools of the Southern States

Educational Research and Statistics:

The Social Beliefs of College Freshmen: GEORGE J. DUDYCHA. *New Type and Essay Examination Scores:* STEPHEN M. COREY

DECEMBER 27

The Retiring Day: E. M. FREEMAN

A Few Problems of the High-school Teacher: GUSTAVE A. FEINGOLD

Educational Events:

The British Educational Films Commission; Charles and Julia Henry Fund Scholarships for British and American Students; The Brooklyn Children's Museum; Federal Legislation on Infant Welfare; A Linguistic Atlas of the United States; Summer Session for Extension Workers at the University of Wisconsin; Examination for Psychologists in the Public Schools of New York City; Annual Meeting of the Association of American Colleges

Educational Notes and News

Discussion:

Special Reports as a Method of College Teaching: C. R. WISEMAN

Special Correspondence:

Cooperation between Goucher College and the High Schools of Baltimore: DAVID A. ROBERTSON. *Education in Poland:* CAROLINE BENGTSON

Quotations:

Intercollegiate Athletics; Registration Statistics

Reports:

Survey of the Land-grant Colleges

Educational Research and Statistics:

The Classification of High-school Students: STANLEY S. MARZOLF

JANUARY 3

The Teacher as Cobbler: JOHN ADAMS

Educational Events:

The London Schools; Revision of the Juvenile Statutes of Massachusetts; Safety Education; National Advisory Committee on the Education of Negroes; The Scholastic Rating System of the Massachusetts Institute of Technology; The Hubert Bequest

Educational Notes and News

Discussion:

1931 as a Centennial Year in the History of Education: WALTER CROSBY EELLS. *The So-called Honor System:* JOHN PALMER GAVIT

Special Correspondence:

Mennonite Schools and Colleges: SILAS HERTZLER
Subsidizing Scholarship: OSCAR A. ULLRICH

Quotations:

College Athletics

Educational Research and Statistics:

Leadership in Curriculum Building in Large City School Systems: MARGARET ALLTUCKER NORTON.
Constants and Variables in the High-school Program of Studies: EARL W. BAKER

Index to Volume XXXII

EDUCATIONAL REVIEW

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Health and Protection, at Washington, from November 19 to 22.

The flarimeter, an instrument which will disclose whether a person has heart disease in advance of serious developments by measuring shortness of breath, was demonstrated by Dr. P. V. Wells, of Newark, N. J.

A new barbituric acid derivative, the sodium salt of isoamylethylmalonylurea, was discovered and found to be valuable to the surgeon in producing a state just short of deep sleep.

Calcium gluconate, formerly only a laboratory curiosity, was discovered to be an effective medicine.

Recognitions and Awards

For his researches on light, particularly the discovery that monochromatic light when scattered by shining on certain transparent substances is partly changed to other colors, Sir Chandrasekhara Venkata Raman, professor of physics at the University of Calcutta, was awarded the Nobel Prize in physics.

The 1930 Nobel Prize in medicine was awarded to Dr. Karl Landsteiner, of the Rockefeller Institute of Medical Research, for the discovery that human blood is of four different types and that blood of one type does not always mix with blood of another type.

The Nobel Prize in chemistry was awarded to Professor Hans Fischer, of Munich, for his achievement in the laboratory production of hemin, one of the components of hemoglobin, the red coloring matter of blood.

The Daniel Guggenheim gold medal for notable achievement in aeronautics was awarded to Dr. Ludwig Prandtl, professor at the University of Gottingen, Germany, for "pioneer and creative work in the theory of aerodynamics."

The distinguished flying cross of the Navy was given to all members of the Alaskan Aerial Survey expedition which mapped nearly 13,000 square miles of wild country during 1926.

The Collier trophy for the outstanding contribution to aviation was given to the National Advisory Committee for Aeronautics for its cowling for radial air-cooled engines.

Dr. George H. Whipple, of the University of Rochester, and Dr. George R. Minot, of Harvard University Medical School, shared the first \$10,000 *Popular Science* annual award given in recognition of their discovery of a successful treatment of pernicious anemia by the liver diet.

The Harmon Trophy for the outstanding achievement in aeronautics was awarded to Carl B. Eielson who piloted Sir George Hubert Wilkins across the Arctic.

The Perkin medal was awarded to the late Dr. Herbert H. Dow, president of the Dow Chemical Company, for his developments of improvements in the production of chlorine, bromine, magnesium and other chemicals.

The James Douglas Medal of the American Institute

of Mining and Metallurgical Engineers was awarded this year to John V. N. Dorr, president of the Dorr Company, for "his invention of apparatus and achievement in developing and improving hydrometallurgical practice."

The National Academy of Sciences' public welfare medal was given posthumously to Stephen T. Mather, organizer of the U. S. National Park Service.

The National Academy of Sciences' Daniel Giraud Elliot Gold Medal was awarded to Dr. Henry Fairfield Osborn, of the American Museum of Natural History, in recognition of his scientific monograph describing the ancient titanotheres, a prehistoric creature somewhat resembling the rhinoceros.

A gold medal and accompanying annuity of from \$100 to \$500 to be given government workers for scientific achievements was proposed in a bill before the Congress.

The William H. Nichols Medal for 1930 was presented by the New York Section of the American Chemical Society to Samuel E. Sheppard, of the Eastman Kodak Company, for his "outstanding achievement in the chemistry of photography."

The Willard Gibbs Medal was awarded to Dr. Irving Langmuir for "fundamental work on atomic hydrogen and on surface relations and also on electrical discharge phenomena; also for his contributions of great importance to nearly all branches of physical chemistry, including high vacuum technique, electronics, thermochemistry and catalysis, and lastly for his presentation of a theory of atomic structure."

The John Fitz Medal was awarded Rear Admiral Watson Taylor, U. S. N., retired, for his engineering achievements, the most notable of which is his utilization of the bow wave in ship propulsion.

The Edison Medal of the American Institute of Electrical Engineers was awarded to Professor Charles F. Scott, of Yale University, for his pioneering work in electric transmission.

The Franklin Medal, awarded by the Franklin Institute, was given this year to Sir William Bragg, director of the Royal Institution of Great Britain.

In recognition of his demonstration that protons act like waves, Professor Arthur J. Dempster, of the University of Chicago, was awarded the \$1,000 prize given annually by the American Association for the Advancement of Science.

The Hoover Medal was awarded for the first time, the first recipient being President Herbert Hoover.

The American Pharmaceutical Association gave its Ebert Prize for 1930 to Marvin R. Thompson, of the University of Maryland, for his work on the pharmacology of ergot.

Dr. R. R. Spencer, of the U. S. Public Health Service, was awarded the American Medical Association's gold medal for original work in preparation of a vaccine for Rocky Mountain spotted fever.

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SCIENCE NEWS

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ECLIPSES, COMETS AND EROS IN 1931

THOUGH 1931 will be more generous in the matter of eclipses than are most years, no astronomers are expected to travel to see them. Their main attention, during the early part of the year at least, will be devoted to a tiny speck of light in the sky too faint to be seen without a telescope. Several comets are due, but, as far as astronomers can tell at present, none will be visible to the unaided eye.

Five eclipses are on the 1931 program, but none will be seen from the United States. Three are of the sun, but all are partial, so the corona, and other features that appear when the moon completely covers the sun, will be absent. Therefore, astronomers will make no efforts to observe them. If they did, they would have to do some traveling, for the first, on April 18, is visible from Siberia and the North Pole. The second, on September 12, will be seen from Alaska, while the third will be seen on October 11 from the southern tip of South America and the South Pole.

The eclipses of the moon are total, that is, the moon will completely enter the shadow of the earth. The first will occur on April 2, the second on September 26. Both will be seen mainly from the Eastern Hemisphere. However, eclipses of the moon are of little scientific value, though of considerable popular interest as a spectacle.

The tiny planet Eros, probably only 15 miles in diameter, is now closer than at any time since its discovery in 1896. On January 29, Eros will be only 16,200,000 miles away. This is closer than any permanent celestial body ever comes, except the moon. The moon, on the average, is 240,000 miles from us, but the sun is about 92,900,000 miles. The close approach of Eros gives astronomers the opportunity to make accurate measures of its distance, and from these they can calculate other dimensions of the solar system, and the distances of the stars. Therefore a wide variety of observations are being made, even though the planet is too faint to be seen without a telescope.

Among the periodic comets that are expected to return to the vicinity of the earth are: Encke's, last seen in 1928; Tempel III-Swift, last seen in 1908; Neujmin's, last seen in 1913, and Schorr's, last seen in 1918. Of course, there is always the possibility that a new and unheralded comet may appear, and that it may be of extraordinary brilliance. None of these mentioned, however, are likely to become bright enough to be seen with the unaided eye.

If the promise given by the fine display of Leonid meteors, or "shooting stars," last November is realized, next November should see an even finer display about the fifteenth. If this happens, it, in turn, may forecast a still greater exhibition a year or two later, possibly rivaling the famous showers staged by these meteors in the past, especially 1799 and 1833. The Perseid meteors, in August, will probably be moderately numerous, as usual.

DR. CRILE'S "AUTOSYNTHETIC CELLS"

BY DR. D. T. MACDOUGAL,

*Research Associate, Carnegie Institution of Washington**Copyright, 1931, by Science Service*

To the biologist concerned with the form and architecture of the living cell, the announcement of the results of Dr. Crile's researches on masses of stuff which show some of the properties of living matter will come as something of a shock.

The physiologists, however, especially the group who are engaged in studying the properties and the ultimate arrangement of particles in protoplasm, find in Dr. Crile's results many things of absorbing interest. Furthermore, there is a growing belief among workers that we may within the near future be able to set up small masses of material in the condition of a jelly in which many of the activities characteristic of living matter may take place.

Thus, for example, I have definite recollection that Jacques Loeb, whose researches are well known to all biologists, expressed high hopes that something like living matter would be compounded within the laboratory within a very few years.

Many of the experimental attempts in this direction have gone no further than the making of minute blobs of colloids which on the glass slide and under the microscope gave resemblances to the indefinite and constantly changing forms of the amoeba. The physiologist is primarily concerned with the energetics, performances or processes which go on unceasingly in living matter. In my own experiments in this direction, begun in 1922 at the Desert Laboratory of the Carnegie Institution, in Arizona, I went no further than making capsules of cellulose, lining them with mixtures of jellies made up of the materials which enter into the composition of the plant cell.

Although the intimate arrangement of these materials could not be said to have been identical with that in living material, except in a general way, yet these experimental devices displayed two forms of activity quite similar to that of the absorbing hairs of roots. In an often-repeated series of experiments the permeability of these jelly layers was found to be similar to that of the tissues of living plants. The common mineral nutrient elements sodium, potassium, magnesium and calcium entered these "artificial cells" at the same relative rates as in a piece of living tissue.

The second performance in which the activity of living stuff was imitated was one in which these "artificial cells" maintained their acidity for days at a time when immersed in an alkaline solution, after the manner of the protoplasm of a plant growing in an alkaline soil.

Some of these experiments were shown to Dr. Crile at the Desert Laboratory. I have therefore viewed these exhibits of Dr. Crile's results at the Cleveland meeting of the American Association for the Advancement of Science with considerable interest.

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Dr. Crile brings together proteins, lipoidal brain extracts and mineral salts in small cavities on glass slides. Masses of material resembling unicellular organisms of various types appear in a few seconds.

The chief interest, however, lies in the fact that when quantities of this material sufficient for chemical and physical tests are accumulated, with characteristic electric potentials, stainability and other physical properties are readily measurable, and respiration data similar to those of masses of living tissue are secured. The transformation of energy indicated is at a rate which changes and runs through a cycle after a manner shown only by living organisms.

Only the worker who has engaged in experiments of this kind is in position to appreciate the enormous amount of wearisome labor necessary to secure the most meager results. It may be regretfully said that the difficulties attending a repetition of Dr. Crile's experiments will delay a checking-up of his results by other workers, which is so highly desirable in all scientific research.

Neither Dr. Crile nor any one else makes the claim that he has actually "created life" in the laboratory. But the way is indicated along which we must travel in the endeavor to gain a fuller understanding of the nature of living matter.

REACTIONS OF NON-LIVING MATTER

THE ability to learn and remember is probably not confined to living organisms.

An important mathematical investigation by Dr. N. Rashevsky, of the Research Laboratories of Westinghouse Electric and Manufacturing Company, has shown that certain mixtures of lifeless fluid substances ought to show behavior indistinguishable from what we call memory. Properly chosen combinations of liquids will respond to repeated changes in the temperature, pressure or other conditions to which they are subjected, as if they were sensitive to their past experience and could put two and two together.

Apparently this unique behavior is possible in a system which may come to rest in more than one position. For instance, a rectangular block may be in equilibrium when resting on any one of its faces. In addition, however, there must be a lag in the changes within the mixture itself, by which when the substance is displaced from its resting condition an appreciable time is required for recovery. Dr. Rashevsky has actually proved that such mixtures would show Pavlov's famous conditioned reflex which is the foundation of behavioristic psychology.

It is not suggested that this is the exact physical mechanism of memory in living animals. Further, no such mixture has yet been made and tested in the laboratory, though the mathematics makes that sequel probable. However, this is one of the most daring and well-informed attempts to handle a question of psychology and biology by the method of mathematical physics.

THE FIGHT ON CANCER

OPTIMISM and determination were the guiding spirits which pervaded the cancer symposium held in Washing-

ton on January 7 under the auspices of the National Institute of Health.

Seven of the leaders in the fight against the disease which is the second greatest killer of mankind described their part in the combat and their war plans. All of them admitted the strength and power of the enemy. But they all were determined to make this a fight to the finish.

Not even the statement by Dr. J. W. Schereschewsky, of the U. S. Public Health Service, that cancer has undeniably increased, dampened the hopeful, fighting spirit of these men. He said: "The conclusion was reached that in the 21-year period from 1900 to 1920, about two thirds of the increase observed in the cancer death-rate of persons 40 years and over was due to an actual increase in the mortality from the disease."

"We may venture to hope that the cancer death-rate will not continue to grow indefinitely." All physical, chemical and biological processes tend to a state of equilibrium. Even without the discovery of preventive measures, the cancer death-rate will sooner or later become stabilized.

The fact of the increase in the cancer death-rate, however, should serve as a spur to stimulate research and to justify its extension. Dr. Schereschewsky described the work in his laboratory at the Harvard Medical School where the effect of high-frequency electricity on tumors is being studied. Transplantable tumors in laboratory animals dry up and disappear when placed in the field of these currents which are similar to the short waves of radio. However, deep-seated tumors are not so easily influenced by the rays. The amount necessary to affect them is apt at the same time to damage neighboring healthy tissue.

Chemists and pharmacologists are also engaged in the fight on cancer. At the National Institute of Health, Dr. Carl Voegtlin and his associates are studying the chemistry of the cancer cell, hoping to learn from this the reason for the tumor's destructive action on surrounding normal tissue and its infiltrating growth.

In Baltimore, Dr. Geschickter, of the Surgical Pathological Laboratory of the Johns Hopkins Medical School, has also been working with chemicals, trying to produce a stain which will show up the cancer cells in a microscopic section of tissue. He described a new method of staining such tissue, but stated that this is not a specific stain for cancer diagnosis. That remains to be discovered.

Approaching the problem from another angle, George O. Gey, of the department of embryology of the Carnegie Institution of Washington, has been "culturing" or growing human cancer cells in his laboratory. This has been attempted a number of times, but the difficulties are great. Mr. Gey has succeeded in cultivating certain types of cancer cells, the sarcoma cells, for many generations. It appears that he will be able to carry this strain on indefinitely. Moving pictures of these and other cancer cells were shown by Dr. Warren H. Lewis, in whose laboratory Mr. Gey has carried on his work.

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EPIDEMICS OF INFLUENZA

A SLIGHT increase in influenza this year over last, with no big outbreak until 1932, is the probable forecast for this disease, based on a survey of the past ten years made by the Metropolitan Life Insurance Company.

The statisticians of the company point out that because ten years is not a very long time in the history of the disease, and because the great pandemic of 1918 does not exactly fit into the picture of a three-year cycle, no definite prediction can be made.

"From such a short period it would be hazardous to draw any sweeping conclusions," they stated. However, their records show that every three years since 1920 has seen a big increase in the cases of influenza. The big years, 1920, 1923, 1926, 1929, were followed by two years of comparatively few cases of the disease.

The seasonal peaks in all the years correspond closely in the company's records. In the second year after an outbreak, the seasonal peak is a little higher than in the first. Such a seasonal increase during the next few months would indicate that the disease is following its usual cycle. So far, no increase in cases of influenza has been reported to the U. S. Public Health Service at Washington.

While the 1918 pandemic does not fit into the three-year cycle, it had many unusual features, which indicate that it may stand alone as an exception to the rule. For instance it did not follow the usual seasonal course, but broke out suddenly in September and continued high for about 8 months. The three-year outbreaks, on the contrary, start in about the first of the year and reach their peak in February or March.

"If the general character of the triplets of annual waves observed in the past ten years should continue to show itself in the future, then the year 1930, with its low death-rate from influenza, would be typical in its position immediately following the high crest of 1929"; the company's report stated. "It would be followed in 1931 by a wave of somewhat higher but still moderate crest; and the year 1932 would then follow with another maximum death-rate, not to be equaled again for two years thereafter."

Officials of the U. S. Public Health Service do not think the occurrence of influenza epidemics can be described by the term cycle, and they likewise state that no prediction as to the time of the next epidemic can be safely made.

Their records show epidemics in the years 1920, 1922, 1923, 1926, 1928 and 1929. These records are compiled from reports of state health officers and include the general population of the country. The insurance company's records, based on illness among their policy holders, are limited to the industrial population. This probably explains the difference in naming epidemic years.

ITEMS

HUMBLE but hardy plants able to grow in a soil utterly without the all-necessary nitrogen salts are described by Professor Robert F. Griggs, of George Washington University, who has just returned from a botanical expedition to the Katmai volcanic region of Alaska,

conducted under the auspices of the National Geographic Society. When Katmai exploded, about twenty years ago, it devastated a great area of country, covering it with raw, naked volcanic ash. How plants could gain a foothold on this new desert, devoid as it was of some of the indispensable elements for plant life, was a question that interested botanists. The plants have been answering. The pioneers have been liverworts, which are a group of green creatures related to the common mosses, but a step farther down the evolutionary ladder. Though the soil they grow on contains no nitrogen the plant bodies themselves have it. It must therefore be assumed either that the liverworts themselves capture this element from the air or that some microscopic plant or animal associated with them does it for them, just as the nodule bacteria capture nitrogen for the clovers on whose roots they form their colonies. Professor Griggs will study his liverworts in the laboratory in an endeavor to find an answer to this question.

CHEMISTS at the University of Missouri, under the supervision of Dr. Herman Schlundt, have started the only known factory in the United States for refining radium from the paint off luminous dials of old watches and clocks. Already several thousand of dollars' worth of the precious element has been recovered in this manner. Out of several hundred pounds of paint about one hundredth part of an ounce is radium. At the present market price this element is nearly \$70 a milligram, or almost \$2,000,000 an ounce. A refining plant for mesothorium, another commonly used radioactive element, was also established by Dr. Schlundt, at the University of Missouri and has been in operation several years. Last year between \$25,000 and \$50,000 worth of mesothorium was refined.

HUMAN skin is more than a mechanical protection against infectious diseases. It is an efficient external organ for killing pathogenic microorganisms, or disease germs. Drs. Harry A. Singer and Lloyd L. Arnold, of the Research Laboratory, State Department of Health, Chicago, applied broth cultures of disease-producing bacteria to skin surfaces. They found that within ten minutes from 90 to 95 per cent. of all the bacteria were killed. The germs of typhoid fever were among the bacteria most readily killed by human skin. These results, however, were obtained only with clean skin. On dirty or greasy skins the same bacteria survived for many hours. The finger-nail region was deficient in bacteria-killing power.

THE spot in the sea off the west coast of Mexico, which was shaken by earthquakes twice during the latter part of November, was again the scene of a heavy shock which might have done considerable damage had it occurred on land. This was indicated by reports from nine seismological stations to *Science Service*. The earthquake occurred early the morning of January 2, at 4:48.6 Eastern Standard Time. The epicenter, or point of greatest disturbance, was located by the U. S. Coast and Geodetic Survey at 17.8 degrees north latitude, and 108 degrees west longitude.

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SCIENCE NEWS

Science Service, Washington, D. C.

MECHANICAL MODELS OF MOLECULES

VIBRATIONS of steel balls and spiral springs now give science exact information on the motions occurring in actual molecules far too small to be seen. Dr. C. F. Kettering, general director of General Motors Research Laboratories; Professor D. H. Andrews, now at the Johns Hopkins University, and L. W. Shutts, also of the General Motors Research Laboratories, have agreeably surprised physicists all over the world by constructing mechanical models in which the various kinds of atomic vibrations occurring in, for instance, a molecule of benzene can be visually observed. These models reproduce with exactness the light radiations or spectra from liquid benzene.

The models are constructed of steel balls connected by spiral springs. The balls are the same relative weights as the carbon, hydrogen or oxygen atoms they represent. The web of balls and springs is freely suspended and connected to a vibrating rod whose speed can be varied by an electric motor. At definite frequencies of vibration, which are recorded on a counter, the model takes up a characteristic motion.

Those rates at which the model resonates are found to agree remarkably with the frequencies observed in light scattered by the substance.

The investigators postulated that the forces connecting the atoms in a molecule are the same as if the atoms are connected by spiral springs. These forces were imagined to lie in the chemical bonds which elementary students of chemistry represent when they write chemical formulae.

A spring can either stretch or bend. Specific heat measurements previously made by Professor Andrews showed that probably the same is true of the chemical bond. Equally surprising was the further result that the elasticity or springiness of all bonds is the same no matter what atoms are joined by them.

The first model made was of benzene, a molecule consisting of six atoms of carbon and six of hydrogen, and was made rather diffidently. Definite numerical results were not expected. In constructing the model, the springs had to be strong enough so that the stretching and bending forces on the balls would be large in comparison with gravitational forces. Also the balls and springs had to be so related that the vibrations would be of a speed that could be observed by the flickering light of a stroboscope. The models were suspended by thin rubber bands, much weaker than the springs.

A stroboscope permits the observation of more rapid vibrations than can be seen with the naked eye if the frequency of the flicker is brought close to the frequency of the oscillations.

A chart of the rates of vibrations was made. It was immediately recognized that the arrangement of lines was practically identical with those in the so-called Raman spectrum of benzene, which is also due to vibrations within the molecule. A simple calculation then

enabled the investigators to convert the model's rates of vibrations into Raman frequencies.

The Raman spectrum is obtained by observing through a prism spectroscope the light scattered by a liquid or solid from a beam of light. Mercury arc light containing only single wave-lengths was used. The original lines of the mercury spectrum are accompanied in the scattered radiation by subsidiary frequencies which are found, on examination, to be due to vibrations of parts within the molecule. These are also shown by the heat radiated by the substance. The 1930 Nobel prize winner in physics, Sir Chandrasekhar Venkataram Raman, of the University of Calcutta, discovered the effect that bears his name.

The benzene model vibrated in several ways. The two halves sometimes vibrated like a bird flapping its wings, or three atoms went up while the alternate three went down, or all six atoms went in and out from the center.

Models of toluene, carbon tetrachloride, chloroform, ethane, ethylene, acetylene, ethyl and methyl alcohol were also made and found to give good agreement with their Raman radiations.

By watching the motion of the parts of these models, the chemist gets a real moving picture of the way the atoms are behaving in a chemical compound and this enables him to understand many obscure points of chemical behavior.

PRESERVATION OF FOODS BY ULTRA-VIOLET RADIATION

NEW ways of preserving food, enhancing its bone-building vitamin content and retaining fresh flavor and odor through the use of invisible light have been discovered. The discovery and its development to the point of commercial application is due to Professor George Sperti and his associates of the basic science research laboratory of the University of Cincinnati.

Narrow bands in the "rainbow" of invisible light or ultra-violet radiation were found to produce these beneficial effects upon food products. By exposing milk and other foods to these special wave-lengths of ultra-violet radiation, it was found possible to produce the artificial antirachitic vitamin D without an offensive taste and smell in the food. In this respect the new discovery, which will be commercialized by the General Foods Corporation of New York City, is claimed to be an improvement on the previous methods of activating foods that have been in use commercially for several years.

Foods treated with ultra-violet light act in all ways as if they contain vitamin D, which prevents rickets. By using only a part of the total ultra-violet band of light waves, Professor Sperti, the director of the laboratory, has been able to produce much larger quantities of the vitamin. He avoided also the simultaneous destruction of the active substances by other constituents of the ultra-violet region, which occurs with the older method.

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Filtered ultra-violet radiation promises to be effective in preserving food products as well as in increasing the vitamin D content. Professor Sperti and his associates found it possible to sterilize milk, orange juice and other food products by exposing them to narrow spectral limits of the invisible ultra-violet light.

Basic patent protection for the principle of selective irradiation has been claimed by the investigators. The method depends on the existence of a critical wave-length at which biological reactions begin and applies to all kinds of radiations. A given effect occurs with shorter wave-lengths, that contain larger quanta of energy, but longer wave-lengths than the critical one are inactive.

If yeast used in making bread is irradiated with a narrow frequency band of x-rays, unwanted mold cells that would spoil the bread after baking are killed, while the yeast cells are unharmed.

The success of these researches has led the General Foods Corporation to sponsor at Cincinnati the inauguration of a new General Development Laboratories whose business it will be to conduct further investigations along similar lines.

THE USE OF CORN SUGAR

ACCORDING to a decision announced by Secretary Arthur M. Hyde, pure, refined corn sugar may be used to sweeten prepared foods without so stating on the label. Corn sugar sold in package or bulk must be labeled as such.

However, dextrose, which is the sugar obtained from corn, is not as sweet as sucrose, the sugar obtained from sugar cane. Consequently more corn sugar will have to be used to achieve the same flavoring effect in foods. Increasing the sugar, whether in the form of dextrose or of sucrose, increases the calories. Herein lies the danger to the unsuspecting.

The general public may be affected, as well as the obese, by an increased use of corn sugar which is expected to result from the new ruling. "The American dietary will probably be still further excessive in carbohydrates unless the people continue to learn to eat more intelligently," the American Medical Association pointed out with reference to the extra amount of sugar that must be used for flavoring when corn sugar is substituted for cane sugar. The American diet has been severely criticized because it contains too much sugar in proportion to other foods. Sugar is an energy food, but lacks vitamins and other important food elements.

Aside from the potential danger of increasing the carbohydrate consumption of the country, the ruling, as it affects sugar alone, will not have any harmful effect on the health of the country. "It is generally admitted," according to the American Medical Association, "that the use of corn sugar in the place of cane sugar in packaged foods of all varieties does not raise, in any sense of the words, a public health problem." The ruling places an added responsibility on the Department of Agriculture to prevent any undermining of the Food and Drug Act. "The decision may make necessary, at least temporarily, a larger service for inspection and a

more rigid control over labels and even over advertising."

LIBERIA SUFFERS UNDER HOST OF DISEASES

A HOST of tropical diseases and many non-tropical ones are rife in the Republic of Liberia. Among them are malaria, blackwater fever, leprosy, elephantiasis, yaws, syphilis, smallpox, chicken pox, sleeping sickness, pneumonia, yellow fever, tuberculosis, rheumatism, dysentery, beriberi and nutritional diseases. About the only ones missing are bubonic plague and relapsing fever.

Public health and sanitation are absolutely lacking. There is no public water supply. Even in the capital city, Monrovia, wells and cisterns are the only sources of water. There is also no sewage system, and the wells are dug in the extremely porous soil of the back yards where the outhouses are found. Three or four physicians and "one building called a hospital" represent the extent of medical facilities for the entire country of 43,000 square miles with a population of about 2,012,000.

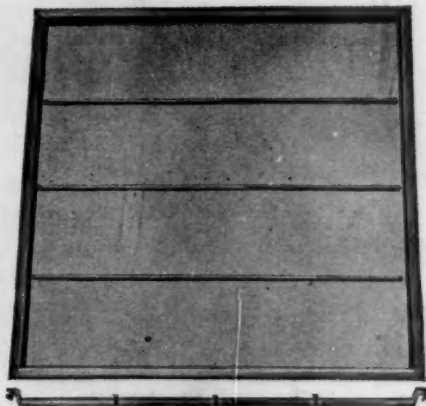
In spite of extremely fertile soil and equable climate, the governing class of Americo-Liberians and all the visiting foreigners must get their fruits and vegetables out of cans. Such is the picture of the country painted by the Harvard African Expedition and by Dr. Howard F. Smith, of the U. S. Public Health Service.

While the country is bankrupt, lack of funds is not the only hindrance to sanitation and health work, Dr. Smith found. He was sent to Liberia shortly after the last American Minister to the country, Charles B. Francis, died there of yellow fever. Dr. Smith expected to assist the Liberian Government organize its sanitary and public health activities, particularly with reference to the eradication of yellow fever, in accordance with an agreement between the American and Liberian governments. He is returning now, since complete lack of co-operation from the Liberian Government made his mission a failure.

The more favored of the population—socially, economically, politically—take the attitude that God will take care of them and the devil will take care of the rest. Consequently they can not be made to take an interest in public health activities. They do not believe that they themselves will benefit from proper drainage, sewage and water systems, from screening houses and destroying mosquito-breeding places, and they do not care that these measures will benefit others. Besides lack of interest, Dr. Smith encountered actual opposition in his efforts to start sanitary and public health activities.

Liberia's diseases and her lack of public health work are not without importance to the rest of the world. The country has been called "one of the festering spots of West Africa." Liberia's immediate neighbors, Sierra Leone, Nigeria and the Gold Coast Colony, all have active departments of public health, and all are concerned over the situation in Liberia. These other countries have tried to stamp out yellow fever within their own borders. Yet they can never feel safe because

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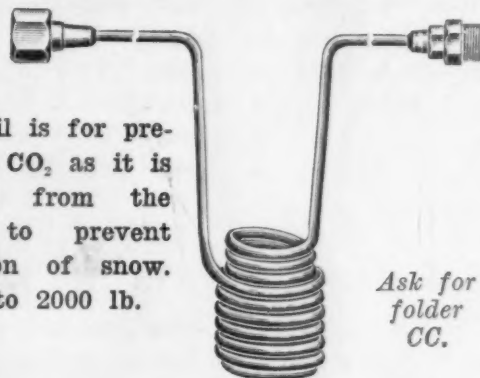
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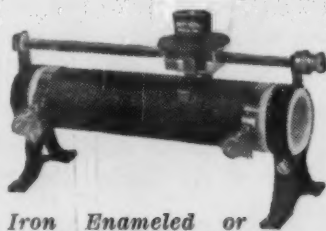
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the disease is always present in Liberia, and may at any time be brought over the border.

Liberia does not report her health conditions to either the League of Nations or the Office International, and never has done so, although she is a member of the League and a signatory to the International Sanitary Convention of 1926.

Liberia has never recorded any communicable disease on any bill of health. These are required of each vessel that clears a foreign port for the United States. They are filled out by the American consul at the port and are supposed to give among other things the number of cases of each communicable disease occurring at or near the port for the past two weeks. This information is obtained from the government of the foreign country, and is part of our protection against the importation of disease. Liberia has failed to furnish this vital information.

CRIME NEWS IN THE PRESS

CONTRARY to popular belief, modern newspapers present news of crime much less extensively than they did a generation and a generation and a half ago.

The amount of crime material available for publication, measured by court records, has nearly tripled since 1890, and yet newspapers have decreased the percentage of their news space devoted to crime. Sensational sex crimes are not nearly as important to the city editor of the present decade as they were to his predecessor in 1905; and such stories were even more eagerly sought and published by editors of the gay 90's.

These are some of the facts learned by Dr. Frank Harris, of Elmira College. Dr. Harris based his conclusions on detailed examination and study of crime news published by three newspapers of Minneapolis during 1890, 1905 and 1921. Court records for the same years were examined so that proper allowance could be made for the increase of crime.

Even when crime increase is not allowed for, the percentage of space devoted to crime compared with the space given all other news shows a decrease. In 1890 slightly more than four per cent. of the news space was devoted to crime news, in 1905 nearly five and a half per cent. and in 1921 less than four per cent.

Because of the great labor involved in the study it was possible to work thoroughly in only one city. However, Dr. Harris believes that his results will apply generally throughout the country, as all newspapers of the United States conform largely to a standard pattern. He also thinks that the decrease in attention given crime news continues past 1921, the last year of the study, though not as rapidly as between 1905 and 1921.

When Dr. Harris took into consideration the increasing availability of crime news, determined by the number of arrests in the three courts of Minneapolis, the decrease in attention given crime by the papers is even more pronounced. In 1890 there were 15,422 arrests and 3,059 articles reporting arrests; in 1905 arrests numbered 20,714 and articles 2,624, and in 1921, 44,448 arrests and 2,737 articles.

ITEMS

THE volcanic outbreaks in northwestern Argentina, reported by refugees at San Antonio de los Cobres, seem to have occurred in a region previously known to be volcanic but quiescent. They may be taken as a pointed illustration of the adage of volcanologists, that a "quiet" or "extinct" volcano is never to be trusted. Data available show three volcanoes along the Argentina-Chile border region that have been in a more or less simmering state for many years. These are Lullailaco, which was observed to be smoking in 1854; Lastarria, also known as Cerro de Azufre, which has been so "dead" that sulfur-mining was conducted in it, and Antofalla, which seems to have been smoking within recent years. All these mountains are very lofty, ranging up to elevations of about 20,000 feet.

MORE uses are being found for the metal, zinc, in automobiles, according to a report made by Robert M. Curts, engineer of the New Jersey Zinc Company, to the Society of Automotive Engineers meeting in Detroit. Rolled, cast and extruded alloys of zinc which show good mechanical properties and resistance to corrosion are steadily replacing more fashionable and costly metals in the manufacture of automobile parts, he declared. Hub or tank caps, and running-board molding can be made of rolled zinc plated with chromium. Die-cast alloys of zinc with copper, aluminum and other metals have been successfully used for such things as gears or windshields. Zinc plated or galvanized iron is coming back into favor for it has been found that its rival, cadmium plate, is actually less resistant to corrosion.

TULAREMIA, or rabbit fever, has been found for the first time in Canada, according to a report of the U. S. Public Health Service. The first case reported was in a miner living near Timmons, Ontario. The second was in a snowshoe rabbit near Vavenby, British Columbia. Because these localities are so widely separated and are both hundreds of miles north of the United States border, it seems likely that the rabbits and other rodents of Canada have been widely infected with tularemia for many years. Further indication of this was found in reports from Canadian observers.

A TROPICAL fungus whose reproductive bodies, or spores, are resistant to degrees of cold never encountered by Arctic plants has been studied by Anna F. Faull, of Harvard University. The material she used in her tests was found on a burnt stump in Cuba after a severe brush fire, and belongs to a species frequently found on burnt-over lands. To test its resistance to heat, Miss Faull subjected its spores to temperatures slightly higher than 50 degrees Centigrade, which is half-way to the boiling point. This had little effect, except that it delayed their sprouting a little. Then she tried the effects of low temperatures, down to the deadly cold of liquid air. But this also failed to discourage this heat-resistant fungus. Miss Faull concludes that the fungus is not especially a heat-lover, as had been supposed, but that it is equipped with high all-round resisting powers.

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PUBLIC HEALTH IN LIBERIA

TEN weeks of mosquito control work by an officer of the U. S. Public Health Service cleaned up yellow fever in Monrovia, capital of Liberia. During the same period, the city's death-rate was reduced 75 per cent., till it was only one fourth what it had been at the corresponding time of the preceding year.

This was accomplished, with small funds and scant cooperation on the part of Liberian officials, by Dr. H. F. Smith, of the U. S. Public Health Service. Dr. Smith has returned somewhat discouraged because the splendid work he started has not been and will not be kept up by the Liberian Government.

However, Surgeon-General Hugh S. Cumming has expressed himself well satisfied with the work. Dr. Smith was sent to control yellow fever in Liberia, an endemic center of the disease, and did exactly that. The year before he was sent there, eight or ten yellow fever deaths occurred among the European and American residents of the city. After his arrival on the scene, there were no more yellow fever deaths and only one case in the entire city. This single case was brought in from outside, but the spread of the disease was successfully checked.

Dr. Smith started his work with a survey of the mosquito population of the city. He found that, since there is no municipal water supply, the residents have large barrels and cisterns to collect rain water during the rainy season. There are also a few shallow wells which are not protected from mosquitoes or from sewage contamination.

Three fourths of the houses in Monrovia proper were breeding mosquitoes in water barrels and other containers on the premises. Over nine tenths of the mosquitoes found breeding in such places about the city were of a species capable of transmitting yellow fever.

In addition to the open wells, barrels and cisterns, each backyard had a collection of empty tins and bottles which provided further excellent breeding places for yellow fever mosquitoes. The year before Dr. Smith went to Liberia, the American and European residents had a general "clean-up" of these collections of trash and refuse. Less than ten months later, when Dr. Smith started his work, he collected 546 truckloads of refuse from the backyards of the city, which has a population of barely 10,000.

The death-rate in Monrovia follows the period of heavy rains closely. The greatest number of deaths have occurred in May, the beginning of the rainy season. It was during this month that Dr. Smith's mosquito control measures, started only ten weeks before, brought the number of deaths down from thirty to seven.

In the course of his anti-yellow fever work, Dr. Smith made a complete survey of the public health situation in the country. He found, among other things, that the only isolation hospital was a small shack rudely made of thatch, without any sanitary conveniences, in which

nine men and women, suffering from smallpox, were housed.

THE USES OF CORTIN

CORTIN, the new hormone extract prepared in a Buffalo laboratory, has kept a man suffering from once-hopeless Addison's disease alive for over six months.

"When first treated this patient was not expected to live," according to Professor Frank A. Hartman and Dr. Katherine A. Brownell, who developed the hormone extract and called it cortin. "Positive proof that the extract keeps him alive has been shown by four relapses which have occurred due to the reduction of extract. A few hours after increasing the extract, following a relapse, improvement is evident and in two or three days recovery is complete."

The extract contains the vital hormone of the cortex of the adrenal glands. When this part of the glands is injured or destroyed, death follows. Addison's disease, which is caused by destruction of this vital adrenal cortex, has always before now been fatal.

Early efforts to study cortical extracts were blocked because it was impossible to get an extract free from epinephrin, the hormone of the medulla of the gland. In 1927 Professor Hartman and associates were successful in preparing a cortical extract almost entirely free from epinephrin. Last year they developed a method of preparing a concentrated extract.

Other investigators, however, had been working on the same problem at other laboratories. In March, before the last method was perfected, Dr. W. W. Swingle, of Princeton University, and Dr. J. J. Piffner, of the laboratory of the Long Island Biological Association, announced a successful method of preparing a similar extract. This extract has been used at the Mayo Clinic by Drs. Leonard G. Rowntree and C. H. Greene, who recently reported that they were successfully treating cases of Addison's disease with it.

The Hartman-Brownell method possesses certain advantages over any other method, its originators claim. It is simple. Very little epinephrin is carried into solution. The extract is not irritating and because of the low epinephrin content, can be injected into veins as well as under the skin and into the abdominal cavity.

Other possible uses for cortin besides treating Addison's disease have been indicated. It increases resistance to infections, Professor Hartman reported. When rats have had their adrenal glands removed, their resistance to typhoid vaccine could be significantly increased by injecting cortin.

Wasting palsy may also be helped by cortin. In a few cases of this disease, known medically as progressive muscular atrophy, cortin has been used with some benefit.

THE SEAPLANE TESTING BASIN

DR. JOSEPH S. AMES, chairman of the committee and president of the Johns Hopkins University, has reported

The Journal of General Physiology

EDITED BY

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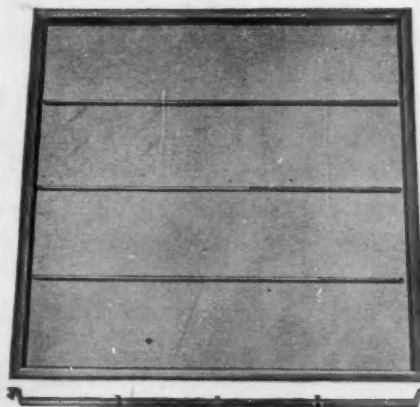
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to the House Appropriations Committee that the new seaplane channel for testing seaplane floats and flying boat hulls, which is being built at Langley Field, Virginia, by the National Advisory Committee for Aeronautics, will be ready for use in about six months. Aeronautic progress in 1930 was also summarized by Dr. Ames.

The testing channel is 2,050 feet long, and will be the first equipment of this character ever constructed and used, Dr. Ames said in his description of the activities of the Langley Memorial Aeronautical Laboratory, which is operated by the National Advisory Committee. A new full scale wind tunnel for testing full-sized airplanes is also being constructed at the laboratory, and will be ready for tests about the same time as the seaplane channel is finished.

Aircraft progress in the year passed is summarized by Dr. Ames as follows: Airplanes are now being purchased on a basis of proved performance. Commercial aviation is about to enter the fourth stage, in which carrying the mail will be a minor part of business, and carrying passengers and express the major interest. Previous stages have been (1) the carrying of air mail by the government planes; (2) carrying of mail by aircraft companies under contract; (3) carrying of passengers in addition to mail.

Air passengers increased 300 per cent. in 1930, over 1929. Different types of airplanes approved increased 123 per cent.; types having two or more engines increased 150 per cent.

No startling innovations for airplanes are in sight now. Improvements from now on are likely to be gradual. Problems to be solved continue to be those of working out greater safety, improved control at low speed incident to taking off and landing, higher speed in flight, increased comfort, less noise and vibration, and general reduction in cost without reduction in airworthiness.

The cowling, developed as a result of past experiments in laboratories at Langley Field to decrease air resistance of air-cooled engines, brought the committee the National Aeronautic Association's Collier trophy in 1930.

Military airplanes particularly are being studied in an effort to improve their maneuverability and controllability; commercial aircraft particularly for safety features and lowered costs.

Dr. Ames believes that the committee is at least approaching a solution for the difficulty of preventing involuntary spinning in military planes; and the difficulty of coming out of a voluntary spin without accident. The vertical wind tunnel has been of great help in studying this particular feature, he said.

The bumpiness of the air is now measured by an instrument devised at Langley Field.

The position of the aircraft industry to-day can not be called that of a large manufacturing industry, Dr. Ames agreed. Hurt by the depression of 1930, the production of airplanes slumped to half the number made in 1929, that is, to about 3,000 planes. Dr. Ames told the House Appropriations Committee that, in his opinion, aviation was forced to some extent prior to 1929.

THE CABLE BETWEEN NEWFOUNDLAND AND THE AZORES

ONE of the latest advances in telegraphic communication, a cable between Newfoundland and the Azores over which 2,500 letters a minute can be sent in one direction or 1,400 letters in each direction at the same time, was described before a recent meeting of the American Institute of Electrical Engineers. At these record rates of transmission the entire Bible could be cabled from Newfoundland to the Azores in about 20 hours and it would take only 35 hours to send the Bible from each terminal to the other at the same time.

The new cable is a part of the Western Union transatlantic system making land connection at Bay Roberts, Newfoundland, with New York City, and cable connection at Horta, Azores, with German and Italian communications, it was explained by J. W. Milnor and G. A. Randall, telegraph engineers, of New York City. The final splice was made in September, 1928.

"This cable combines the advantage of high-speed operation characteristic of the new continuously loaded cable, with the facility of duplex or two-way operation inherent in the old non-loaded type of cable. The duplex speed is several times as high as any long cable has previously been duplexed, and provides the greatest message-carrying capacity of any existing trans-ocean cable."

A cable of such great message capacity could not be built until metallurgists had discovered a new alloy of unusual magnetic properties. This alloy, known as "permalloy" in the United States and as "numetal" in England, is composed of nickel and iron and is more than thirty times easier to magnetize than soft iron, the metal which in the past has had the greatest magnetic permeability. Over 50,000 miles of fine wire made of this metal is wrapped around the copper conductor of the cable.

Another unusual feature of the cable which makes possible the sending of messages in both directions at the same time is the fact that there are "artificial cables" in both Newfoundland and the Azores which duplicate exactly the electrical characteristics of the cable actually under the water.

The resistance of the 1,341.2 nautical miles of conductor is 4,521 ohms. When a 12-volt battery is used for sending in both directions at 1,400 letters a minute, a current of only six thousandths of an ampere is received at the other end of the line.

THE WEATHER OF INDIA AND CANADA

A MODERATE winter on the Canadian prairies is the indication of certain world weather correlation formulas applied by Dr. Charles F. Brooks and Earl B. Shaw, of Clark University, in the current *Bulletin* of the American Meteorological Society.

This computation, applying to the current winter taken as a whole, including the approaching month of February, is based on weather conditions of India and Argentina during last summer.

When India's pressure is above normal for the months from January to October, the following winter in Canada

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and the north central part of the United States is apparently likely to be above normal in temperature as indicated by formulas devised by Fred Groissmayr, of Passau, Germany.

During the months of 1930 before October, India, as represented by Nagpur, has had the high pressure which usually heralds a mild winter for Canada on the other side of the ocean and the globe. And although the other weather factors in India, usually associated with a mild winter in Canada, do not entirely substantiate this indication, the evidence is considered sufficiently strong to form the basis for a reasonable expectation that this winter will not be so cold as the average.

Temperatures in Central Argentina are also thought to have an influence on Canadian winters, and reports from South America add strength to the prophecy of a moderate winter. Mild temperature in Central Argentina is usually followed by a moderate winter in central North America and this year Central Argentine temperature, represented by Goya, was above normal for the months through July.

Investigations of the relationship between Canadian winters and weather conditions in distant parts of the world take into account meteorological records since 1875. During the period from 1875 to 1920, the indications for a mild winter in thirteen instances have been as favorable as they now are and in each instance a moderate or mild winter ensued.

Dr. Brooks and Mr. Shaw concluded that "While present calculations should hardly justify us in counting on a moderate winter, 1930-31, at Winnipeg as a certainty, we can say that all previous indications as strong as those for the present winter being above normal have been correct."

A MASTODON FOUND IN INDIANA

ONE of the largest mastodons ever discovered in America was found in a dried-up pond on the Charles Feldheiser farm, a mile south of Cromwell, Ind., by a 10-year-old boy who was hunting skunk holes. The boy was Donovan Harper. He stubbed his toe over a smooth object protruding from the black mud. Investigating it, he yanked out a molar tooth weighing 8½ pounds. Elated by his find the lad lugged the treasure home. His story led Mr. Feldheiser and others to start digging on the spot where the huge tooth was found. An enormous jawbone soon was uncovered.

One of the neighbors knew a bit about geology and he advised Mr. Feldheiser to communicate with Dr. C. J. Fish, director of the Buffalo Museum of Science. Dr. Fish, accompanied by Watts Richmond, a millionaire sportsman of Buffalo, lost no time in visiting the Feldheiser farm. The Indiana farmer had wisely refrained from further digging into the mastodon "pay dirt." What Dr. Fish and Mr. Richmond saw, however, induced them at once to lease the site of the mastodon graveyard. A few days later the Richmond Expedition of the Buffalo Museum of Science, headed by Dr. John T. Sanford, curator of geology and paleontology of the museum, reached the farm and started excavation operations.

The first act of the scientists after establishing themselves on the Feldheiser farm was to have a wooden shed erected over the spot where the mastodon remains rested, to protect the bones from the weather. Armed with hand trowels, they began a long and slow task of removing a foot of muck and three or four feet of clay from the big beast's remains. The unusually large proportions of the mastodon were realized when the first tusk unearthed measured 12 feet 6 inches in length. This is one of the largest, if not the largest, mastodon found. Dr. Sanford estimates that it probably lived about 10,000 years ago in the post-glacial age.

As the soil was thrown aside handful by handful most of the parts of the giant skeleton were disclosed. The pelvis bone measured 5.3 feet across. Ribs were 4.4 feet long. The lower jaw was 3.2 feet long. The measurements of the humerus, femur and ulna, respectively, were 3 feet, 3.6 feet and 2.2 feet. Six articulated lumbar vertebrae were 1.8 feet long.

In the belief that the dried-up old sink-hole may be a regular mastodon cemetery, the Richmond expedition will conduct extensive excavations there this spring.

ITEMS

THE variability, or periodic change in brightness, of the little planet Eros, now a temporary near neighbor of the earth, is supposed to be due to differences in the reflecting qualities of different parts of its surface, as the asteroid spins about on its axis once in every five hours and sixteen minutes. The decrease in variability may be due to an improvement in the reflecting angle between the sun, Eros, and the earth, as we get closer to a straight-line position in space; for the period of variability remains the same though the amount of variability has greatly decreased. This was the interpretation placed by H. E. Burton, astronomer of the U. S. Naval Observatory, upon the dispatch from Harvard College Observatory stating that the variability of Eros has decreased fifty per cent. in a fortnight. The Naval Observatory has Eros under observation also, Mr. Burton informed *Science Service*, but the astronomers there are concentrating on accurate determinations of its location, without reference to variations in its brightness.

So much public interest has been aroused in the substance, maizolith, developed by C. E. Hartford, Jr., at the U. S. Bureau of Standards, that the bureau has had to take up the work again in order to supply the demands for samples. C. E. Hartford, who was working for a degree at Iowa State, discovered that if cornstalk pulp is put through certain mechanical operations and then combined with water, it will form a tough jelly. When this jelly dries it is tough and horny and much like hard rubber. The Bureau of Standards asked Mr. Hartford to come on the government pay-roll and work on his cornstalk rubber. Mr. Hartford came to Washington, completed his work, wrote a paper on it, and resigned. The bureau considered the matter closed and the work finished, but there developed such a continuous public demand for samples of maizolith that a man had to be put back on the cornstalk rubber detail.

Children Who Run On All Fours

By ALEŠ HRDLIČKA

Curator, Division of Physical Anthropology
U. S. National Museum, Smithsonian Institution



Dr. Hrdlička here reports the results of his long and exhaustive study of animal-life manifestations in the human child, with particular reference to "bear-walking," climbing, sleeping "on all fours," and other apparent atavisms. His book, a pioneer study of an obscure field of child behavior, is based upon almost four hundred cases reported in detail to the author from many parts of the world. In addition to these, he has utilized experience derived from first-hand contact with the phenomena to make interpretations and draw conclusions of obvious interest to anthropologists, physicians, psychologists, and of course, parents.

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PAPERS PRESENTED AT THE CLEVELAND MEETING

THE human eye can see stars about five or six times as faint as the faintest that can be detected with the photoelectric cell, according to the results obtained by Dr. Joel Stebbins, professor of astronomy at the University of Wisconsin, presented before the astronomical section of the American Association for the Advancement of Science. The photoelectric cell yields an electric current when light falls on it. Dr. Stebbins and others have used it to measure the brightness of stars, by measuring the current when the starlight, concentrated by a telescope, shines on the cell. To test the sensitivity of the cell, Dr. Stebbins took it off his telescope and pointed it at a standard candle actually placed a mile away across the lake at Madison. The cell was able easily to detect the light, and Dr. Stebbins estimated that the candle could have been detected if as far as three miles away. The eye can see a candle at six or seven miles, and Dr. Stebbins thinks that the cell could detect it at this distance if the light were white in color, like some of the stars, instead of yellowish. Therefore, the unaided eye is just about as sensitive as the photocell. But the pupil of the eye is about a quarter of an inch in diameter, and when the light is concentrated by a ten-inch telescope lens, the light-gathering power of the eye is increased 1,600 times. The opening of the photocell, however, is about an inch in diameter, so that the same telescope only increases its power about a hundred times. Therefore, in practice, the eye can see fainter stars than can the photocell through the same instrument.

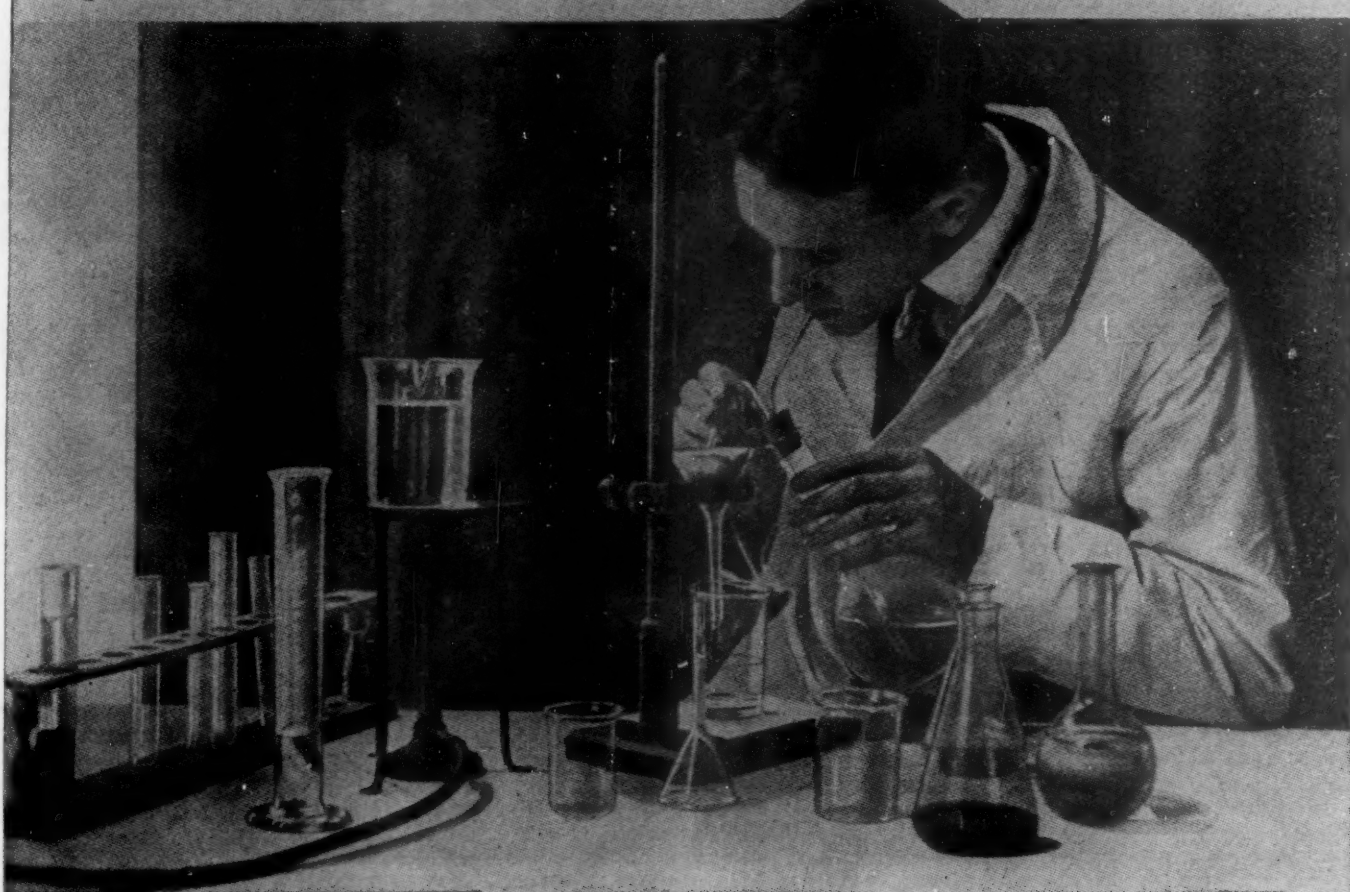
AN apparent influence of the position of the moon in the sky upon radio transmission on the earth has been detected by Dr. Harlan T. Stetson, director of the Perkins Observatory, at Ohio Wesleyan University. Dr. Stetson presented his hypothesis that the hour angle of the moon, that is, its distance from the meridian, is associated with the height of the Kennelly-Heaviside layer. This is the ionized layer in the upper atmosphere that is supposed to reflect radio waves downwards, and so make long-distance transmission possible. For some years Dr. Stetson has studied the reception of the carrier wave from a Chicago broadcasting station and has found good evidence of a connection between the transmission and the number of sun-spots. He attributed this to differences in the height of the reflecting layer. Now his latest studies give evidence that the moon is also involved. The main cycle of variation for sun-spots is about eleven years, but Dr. Stetson's researches have shown a shorter one of about 15 months. It was pointed out that this period corresponds closely with the recurrence of certain arrangements of Venus and Mercury, thus suggesting a possible tidal effect. Dr. Stetson also stated that the maximum of the last sun-spot cycle had occurred about July 1, 1928, while the last two months

have shown the rise of a secondary maximum. This, he said, should be over in a few months, and by the end of 1931 spots will be fewer than since 1925. This will mean an improvement in radio transmission. Last summer's time of minimum activity on the sun had been associated with exceptionally good radio connections, quite contrary to the popular idea that long-distance radio reception is bad in summer.

THE chemist now knows that such a complex mixture of hydrocarbons as occur in petroleum may be obtained through chemical reactions starting with a single, simple mother substance. Dr. S. C. Lind, director of the school of chemistry of the University of Minnesota, in a paper read before the association stated that just how these reactions are brought about in nature is not yet known, but the fact that they can be accomplished in the laboratory indicates their possibility as natural processes. This is a step toward the solution of the great mystery of the origin of the oil in the crust of the earth. But it does not settle the question as to whether the processes of nature manufacture petroleum from a vegetable, animal or inorganic source. By application of heat and pressure, or by bombardment with the alpha rays from radioactive substances, it is possible to obtain from a single simple hydrocarbon a synthetic petroleum that is probably just as complex as petroleum occurring in nature. The simplicity of such a mechanism may lend indirect support to the old idea of an inorganic origin from one or a few hydrocarbon gases such as might be produced by the action of water on metallic carbides in the earth's interior. On the other hand, it does not preclude animal or vegetable origin, but strongly suggests that the primary material, whether gaseous, liquid or solid, is later subjected to thermal or ionic agents or both which produce the complexity found in nature.

EXPLOSIONS of dynamite to create artificial earthquakes, and portable seismographs to record them, will be the tools used by the geologists of Harvard University to study the deposits left by the glaciers that once covered a large part of North America. With such methods, which have already proved of value in locating hidden oil pools, it is expected that the exact depth of the rock surface underlying the debris of these glaciers can be determined. Speaking before the section on geology, Dr. L. Don Leet, who has charge of the Harvard seismograph station, told of the plans for these researches. He pointed out that the success achieved by seismic prospecting, as it is called, in locating valuable minerals, had overshadowed the less remunerative but equally valuable scientific possibilities. The earth waves, he stated, travel more slowly through the loose glacial material than through the more solid underlying rock. The method is to discharge a shot of dynamite at a short distance from the seismograph. The waves then travel to the instrument through the glacial layer

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alone. Then charges are set off at increasingly greater distances. Finally a point is reached at which the waves travel partly through the underlying rock, and therefore reach the instrument at a greater speed than before. The exact distance at which this occurs depends on the thickness of the upper layer, and, when it is found, the thickness can be calculated. For the average set of measurements, Dr. Leet estimated that between 100 and 125 pounds of dynamite, discharged along a line 1,000 feet long at 50-foot intervals, would suffice.

THAT several embalmed bodies of gorillas, including the extremely rare mountain gorilla of the Kivu region, are now available for anatomical study by investigators at Columbia University and the American Museum of Natural History, was announced by Dr. William K. Gregory, speaking before the American Association of Physical Anthropologists. The idea of obtaining these specimens was originally put forward by Professor Dudley J. Morton, of the College of Physicians and Surgeons, Columbia University. As a result a joint expedition of Columbia University and the American Museum of Natural History entered the field under the leadership of Mr. H. C. Raven. After prolonged negotiations, the Belgian Government consented to the shooting of two Kivu gorillas, in the area outside of the now rigidly protected Parc National Albert. Mr. Raven succeeded in surprising a huge adult male, which he shot as it charged him, the animal dropping not more than fifteen feet from his rifle. After heroic labor on the part of the Negro porters, the 400-pound carcass was got through the jungle down the mountainside to camp. There it was preserved by injecting embalming fluid into its arteries. This specimen reached New York in excellent condition. A second Kivu gorilla, also a big male, was later shot and embalmed, but the process was not so successful in this case. After securing the two mountain gorillas and making some other studies, the expedition crossed the continent into the French Cameroons, where lowland gorillas live. Dr. Gregory reported that he had just heard from Mr. Raven of good success there, resulting in the addition of several specimens of this second species of gorilla to the collection.

FLOODING rivers in America should not be allowed to continue their careers of rapine and destruction, but should be tamed and exploited for their great resources in land fertility and fish foods. This was the thesis advanced by Professor James G. Needham, of Cornell University, when speaking before the American Association. Professor Needham called attention to the potential wealth in flood waters, as evidenced by the richness of the vegetation on river banks and the abundance of fish in the water. He pointed to China for examples of both the right and the wrong ways of dealing with great rivers. "The condition of the rivers in China shows what has been done and can be done with flood waters," he said. "The contrast in treatment between the Hoang Ho, 'China's Sorrow,' and the Yang Tze, 'China's Sustenance,' is very striking. The Hoang

Ho is diked 70 feet above the plain and, breaking over betimes, floods grow more disastrous as the dikes rise higher; but the peaceful Yang Tze is spread out in canals over the plain, dropping its load of silt in the canals, whence the farmers recover it to fertilize their fields and keep them ever productive. They build the land high, they keep the bottom of the canals low, and the fishes developed in these canals provide nearly the whole of their meat supply. "Studies should be made to find out whether the results obtained in China by means of infinite hand labor might not be attained in the flood plains of American rivers by the application of new methods and the use of American machinery."

To be healthy, a plant, like an animal or a human being, must get its share of mineral salts. But to absorb mineral salts from the soil solution it must be healthy. Living cells do not just soak up mineral nutrients passively; they put vital energy into the job, and require the presence of energy sources, including sunlight, to do their work efficiently. These were among the points put forward by Professor D. R. Hoagland, of the University of California, who delivered the annual Stephen Hales Lecture before the meeting of the American Society of Plant Physiologists. Professor Hoagland's researches on the activities of *Nitella clavata*, a water plant, have shown that when its cells are in proper tone and supplied with the necessary energy they will develop in their interior sap cavity a sap solution containing mineral salts in twenty-five times the concentration at which they exist in the surrounding water. Researches along parallel lines conducted by other workers have given comparable results. These discoveries have more than a theoretical value, since they indicate the importance of keeping the soil around the roots of crop plants well aerated and otherwise ministering to the very important absorbing cells down in the soil, which are the gateways through which must enter all the nourishment for man and his domestic animals.

THE smallest electric current ever measured—about one three-hundred-quadrillionth of the current required to light an ordinary 100-watt electric bulb—can be detected with the aid of a new vacuum tube developed at the research laboratory of the General Electric Company, under the direction of Dr. A. W. Hull. Such a current consists of a flow of only 30 electrons a second. The number of electrons flowing through the 100-watt lamp in a second can be expressed by a ten followed by 18 ciphers. Speaking before the American Physical Society, Professor L. A. DuBridge, of Washington University, told of his researches with this new tube. In the past, he said, small currents have been measured with an electrometer, which is rather a troublesome instrument with which to work. The new tube can amplify currents smaller than one ten-quadrillionth of an ampere, too minute to operate an electrometer. Dr. DuBridge also pointed out that the tube is much more convenient than the electrometer. With its use, the minute current can be amplified millions of times, so that the actual measurement can be made on an ordinary ammeter.

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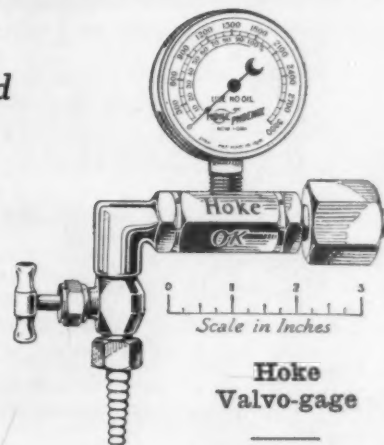


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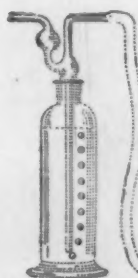
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PROTOPLASM, the jelly-like stuff that is the physical basis of life, can be stretched like rubber, if one employs the proper tools. At the meeting of the physiological section of the Botanical Society of America, Professor William Seifriz and Janet Plowe, of the University of Pennsylvania, reported on tests conducted on this property of the life-stuff. They took hold of bits of protoplasm with ultra-fine needles manipulated under the microscope, and stretched it as far as they could before it broke. Then they treated other cells with various chemicals, and tested the extensibility of the protoplasm after treatment. Some of the chemicals increased the stretchability, others diminished it. Salts of calcium and strontium increased the extensibility, magnesium salts did not affect it, and salts of potassium, lithium and sodium diminished it.

SHORT rations of sunlight for bean plants apparently mean short rations of the protein-making nitrogen captured from the air by the nodule-forming bacteria on its roots. At least, shortened daylight hours impede the development of the nodules themselves, Professor Scott V. Eaton, of the University of Chicago, has discovered. Professor Eaton also reported his researches to the plant physiologists. He grew numbers of soy beans in a greenhouse so arranged that parts of it could be darkened at any time. He shortened the days of various lots of plants to 3 hours, 4 hours, 5 hours, 6 hours, 8 hours, 10 hours. Others he allowed the benefit of the full day, and to still others he gave the added benefit of electric light from 4 o'clock in the afternoon until 10 at night. He also clipped the leaves of some of his plants, to shorten their food supply in this way. Then he harvested them and weighed up tops, roots and

nodules, and chemically analyzed the tissues. He found in general that the amount of certain manufactured plant foods present and the weight of the all-important root nodules decreased together, proportionately to the shortening of the daylight hours, and also proportionately to the degree of clipping to which the plants had been subjected.

LIVER extract, successfully used to check the course of pernicious anemia in human beings, has been used to check the analogous yellowing of plants placed in the dark by Professor Oran Raber, of Immaculata College. The activity of liver extract in checking this yellowing, or etiolation, of darkened plants, raises again the question of the possible physiological relationship between chlorophyll, the substance that makes leaves green, and hemoglobin, the stuff that makes blood red. Liver extract keeps red blood in the veins of the anemic, it now appears to keep green chlorophyll in the leaves of plants.

CORN plants bearing none but male flowers, and others bearing none but female, have been produced by Dr. Donald F. Jones, of the Connecticut Agricultural Experiment Station. Dr. Jones described the work at a meeting of the American Association. Ordinary corn plants bear both male and female flowers. The male flowers are in the tassel, the female in the ear with its silk. Two hereditary factors have been found in a strain of corn, one acting to eliminate the tassel, the other to suppress the silk. If one of these unusual one-sexed plants is crossed with one of opposite sex, the offspring are all normal corn plants, bearing flowers of both sexes. But the second generation offspring will throw off further one-sexed individuals.

INDEX TO ADVERTISEMENTS

Ainsworth & Sons, Inc., William 13
Akatos, Inc. 67
Alsop Engineering Co. 22
American Chemical Products Co. 65
American Instrument Co. 26, 27
American Thermo-Ware Co. 11
Angel & Co., Inc., H. Reeve 11
Baker & Co., Inc. 25
Bausch & Lomb Optical Co. 37, 38, 39, 40
Beck Bros. 66
Biddle, James G. 6
Biological Laboratory of Cold Spring Harbor 18
Boston University School of Medicine 45
Brooklyn Botanic Garden 52
Cambridge Instr. Co. of America 69
Capital Apparatus Works 18
Carver, Fred S. 2
Central Scientific Co. 5
Century Co. 54
Chemical Catalog Co., Inc. 47
Chicago Apparatus Co. 24
Clark Studios, Inc., James L. 15
Clay-Adams Co., Inc. 20, 70, 71
Columbia Univ. Press 60
Comstock Publishing Co. 63
Corning Glass Works 4
Crowell Co., Thomas Y. 57
Degener, Otto 18
Denoyer-Geppert Co. 22
Denver Fire Clay Co. 64

Donaldson, Henry H. 63
Du Maurier Co. 22
Eastman Kodak Co. 12
Eimer & Amend 7
Emerson, J. H. 10
Eppley Laboratory 23
Evans-Adlard & Co., Limited 66
Ferner Co., R. Y. 10
Ferranti, Inc. 18
Fiala Outfits, Inc. 18
Freas-Thermo Electric Co. 68
Gaertner Scientific Corp. 19
General Biol. Supply House 17
General Electric X-Ray Corporation 12
General Radio Co. 20
G. M. Laboratories, Inc. 22
Gravelle, Philip O. 22
Harper & Bros. 54
Hellige-Klett, Inc. 8
Hoke, Inc. 45
Holt & Co., Henry 55
Johns Hopkins Univ. Press 63
Kny-Scheerer Corp. 65
Lea & Febiger 58, 59
Leeds & Northrup Co. 3
Leitz, Inc., E. 16
Login & Son, Inc., B. 63
Loring, J. Alden 20
McGraw-Hill Book Co., Inc. 31, 41
Machlett & Son, E. 10
Macmillan Co. 48, 49, 50, 51
Marine Biol. Laboratory 65
Martini, Walter F. 20

Matheson Co. 15
National Research Council 53
New York Biol. Supply Co. 64
Ohio Chemical & Mfg. Co. 64
PaLo Co. 24
Pennsylvania Biol. Supply House 22
Philippine Journal of Science 52
Rochester University School of Medicine and Dentistry 45
Rockefeller Institute for Medical Research 52
Saunders Co., W. B. 1
Schleicher & Schüll, Carl 43
Schwartz Sectional System 14
Science Press Printing Company 18
Spencer Lens Co. 32, 33, 34, 35
Sterling Products Co. 66
Stylograph Corp. 20
Thomas Co., Arthur H. 36
Triarch Botanical Products 9
University of Chicago Press 61
University of Minnesota Press 62
Ward's Natural Science Establishment 63
Webb, Walter F. 22
Westermann Co., Inc., B. 63
Welch Mfg. Co., W. M. 21
Whittlesey House (McGraw-Hill) 41
Wiley & Sons, Inc., John 28, 29, 30
Wilmot Castle Co. 13
Wistar Institute of Anatomy and Biology 63, 65
Wood & Co., William 56
Zeiss, Inc., Carl 72

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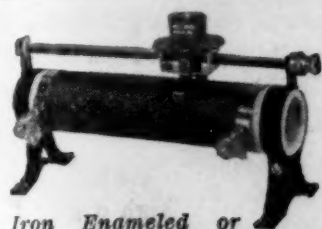
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SCIENCE NEWS

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RELAPSING FEVER

THREE brave men have again offered their lives to help science fight disease. Fortunately they escaped death, modern methods of treatment having cured the disease which they voluntarily contracted for the sake of their fellow men.

They made their heroic contribution to the advancement of science at the Panama laboratory of the Gorgas Memorial Institute. The disease they acquired was relapsing fever, in itself no trifling ailment. But when the three men submitted to the experiment, they had no certain knowledge that the disease they were risking was one known to science and for which science had found fairly effective methods of treatment. The problem which the three volunteers helped to solve was one of those scientific mysteries the account of which, even in the technical report of the institute, reads like a good detective story.

The wild monkeys of Panama have been the subject of study at the laboratory for some time. In the blood of one of these animals, a juvenile squirrel monkey commonly known as a marmoset, a new disease germ was found. This germ belonged to the spirochete family. Members of this family cause various forms of relapsing fever, syphilis and other diseases.

This particular animal had spent three nights on its way into the laboratory in native villages that are endemic centers for relapsing fever, a spirochetal disease. They first concluded that the monkey had accidentally acquired human relapsing fever. Because this would mean that this type of monkey could be a reservoir for the disease, from which humans might acquire it, it was decided to investigate.

A jungle expedition in an area out of contact with human beings yielded two animals that had been infected naturally in the jungle. Back in the laboratory, the disease transferred easily to practically all laboratory animals and monkeys. Most of them recovered quickly from it, but the infant and juvenile squirrel monkeys showed a high death rate.

"We considered this of such importance that another call for human volunteers was made," Dr. Herbert C. Clark, director of the laboratory, reported. Fear of the virulence of the organism limited the human experiment to one man at first. Proof that the disease was transferred to him from the monkey was made by finding the spirochete in his blood. After he had responded well to treatment for relapsing fever, the other volunteers were used.

Human ticks native to the locality were next fed on monkeys acutely ill with the disease. They later fed on the second human volunteer to whom they transferred the disease. The progeny from the eggs of these ticks were then fed on the third volunteer, but without success in the transference of the disease.

Further links in the chain of evidence needed to prove the identity of the mysterious monkey disease are now

being taken. However, the investigators feel they have progressed far enough to say that the disease is either identical to or very closely related to human relapsing fever. Meanwhile, the three volunteers have recovered. To avoid publicity, their names are withheld and they themselves are once more engaged at their regular occupations.

LABORATORY GROWN ERGOT

ERGOT, one of the most important drugs used by physicians, may in future be raised artificially in the laboratories of pharmaceutical factories, instead of being harvested in the natural state as at present. Preliminary experiments pointing to this possibility have been carried out by Miss Adelia McCrea in the botanical laboratories of the University of Michigan.

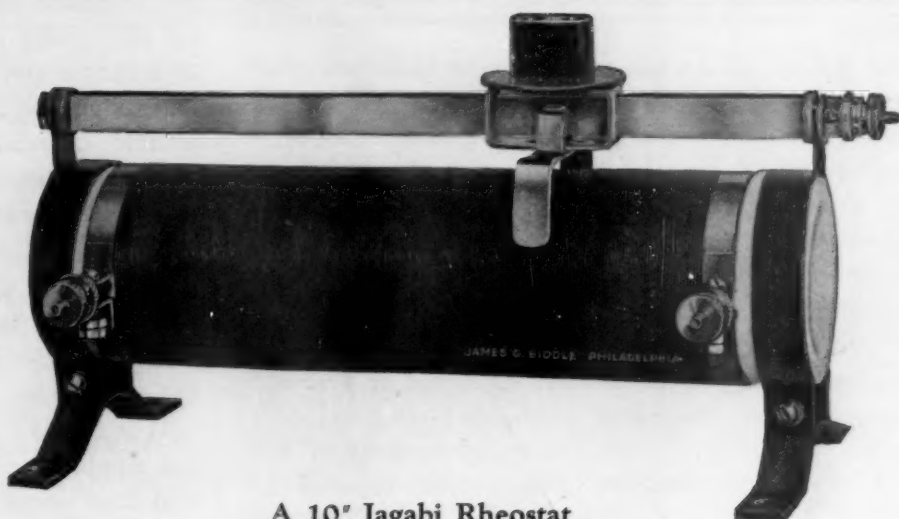
The quality of ergot was the subject of a Senate Committee hearing last June, as a result of charges that the federal food and drugs administration was allowing importation of impure and adulterated ergot. Miss McCrea's research raises the question of whether the growth of laboratory-raised ergot may not be so controlled as to insure a supply of the drug having a high degree of potency. It is too early, however, to consider practical applications of Miss McCrea's work, which is still in the realm of pure science.

Miss McCrea grew cultures of the fungus from which the drug is derived on a variety of media, including mash and jellies made from various kinds of grain, and simpler jellies containing different sugars. She found malt sugar to be the best food for the fungus. To get ergot to grow in a flask or test-tube at all is regarded as a considerable triumph, because under natural conditions it is a parasite, preying only on living plants. She found it to be fairly modest in its food requirements, doing quite as well on a two or three per cent. concentration of malt sugar as it did on six or eight per cent., and failing to thrive at all at higher concentrations.

It was greedy for oxygen, however, growing much faster when a stream of pure oxygen was passed through its tube than when it was given only air. But on a mixture of half oxygen and half carbon dioxide its growth was considerably retarded. It grew best at temperatures between 68 and 77 degrees Fahrenheit. Light had a powerful effect on it. Without the shorter-wave visible rays—the blue end of the spectrum—it did not develop the purple color that is its most marked characteristic. Ultra-violet light, however, had no stimulating effect, and in repeated doses even retarded development.

Miss McCrea made physiological tests of the ergot growths she raised, and found that they produce most of the effects characteristic of natural ergot, though somewhat less powerfully. The reactions averaged from 40 to 75 per cent. of those obtained with the same concentrations of natural ergot. In making these tests, however, she had to use the whole vegetative growth of her

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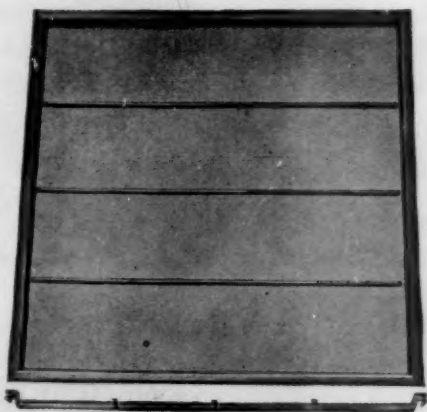
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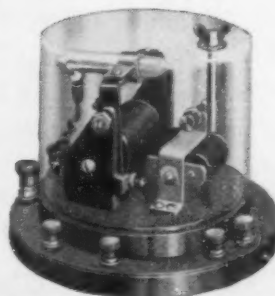
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cultures, for they did not produce the full-grown fruiting bodies which are the only source of commercial ergot at present.

Miss McCrea also made two attempts to infect growing grain with ergot, with the idea that its field cultivation might be undertaken. At present, commercial ergot is obtained solely by hand-gathering of wild growths on grain, especially rye, and wild grasses. Because of the great amount of hand work involved and the high cost of labor in this country, American production of ergot is unprofitable. However, the field experiments did not yield particularly encouraging results, and Miss McCrea concludes that if it ever becomes desirable or necessary to raise ergot in this country the laboratory method is the more promising. A full technical account of Miss McCrea's work is contained in the current issue of *The American Journal of Botany*.

CHEMICAL MOLECULES

CHEMICAL molecules can be handled very roughly without breaking them into fragments, experiments by Professor F. O. Rice and Dr. Harold T. Byck at the Johns Hopkins University demonstrate.

Professor Rice's work gives one answer to a fundamental problem that has occupied the attention of physical chemists for twenty years: how is heat transferred from the walls of a container to the gas inside—which is continuously in motion?

Acetone molecules which ordinarily decompose at a temperature of 1,000 degrees Fahrenheit into the gas methane and other products, were bounced from a white hot platinum surface at 2,900 degrees Fahrenheit without change, in Professor Rice's experiments. Previously it had been assumed that a certain fraction of the molecules sit down on the surface for a while, then get up and leave. When things get this hot it seems they can not be persuaded to stay.

Many chemical substances decompose when heated, as the amateur housewife knows from her cooking. Professor Rice has been attempting to decide whether this decomposition is due to the heat rays from the walls of the vessel enclosing the substance or to the fact that at higher temperatures the gas molecules collide more violently with each other.

In earlier experiments with Professor H. C. Urey and Dr. R. N. Washbourne, molecules were heated but collisions between molecules were prevented by having all the molecules of gas moving in a procession through a very hot furnace. These experiments showed the heat radiation alone was unable to cause chemical change. And apparently there are also some kinds of collisions of molecules that are equally ineffective in producing chemical changes.

A NEW TYPE ELECTRIC ILLUMINATING UNIT

THE development of a new type of electric illuminating unit which, it is said, uses only half the power required by present incandescent filament bulbs and gives a softer and more uniform light has been announced by Claude Neon-Lights, Inc.

The new lighting unit is the result of refinement of the red, tube-like electric signs which have come into wide use during the past few years and brings to more complete development inventions of Georges Claude, the French engineer and scientist who last year conducted notable experiments at Matanzas, Cuba, to get power from temperature differences of sea water.

A very high voltage is needed to operate the red signs, but the new lighting units radiating either incandescent white light or a light containing approximately the same wave-lengths as that from the sun can be used with ordinary house wiring of either 110 or 220 volts, alternating current.

It is stated that these new low voltage units are ready for application in the industrial and commercial field and that lamps for general household use will be manufactured soon.

Glass tubes which can be made in any length from several inches to several feet and containing the rare gases of the atmosphere—helium, neon, argon, krypton and xenon—are the most conspicuous elements of the new unit.

The initial cost of the new lights will probably be higher than that of types now in use, but when the saving in power consumption is considered the cost over a considerable period of time is expected to be less than that of present electric illumination.

The new tubes distribute light evenly and have a soft, non-glaring quality. It is possible to look directly into the exposed tubes for several minutes and turn immediately to read fine print, without undue eyestrain. They do not require heavy diffusing glass which would greatly cut down their efficiency, and they give off much less heat than incandescent lamps.

Four years of laboratory research work and tests have yielded four new developments which make the new units possible. First, the correct mixtures of the rare gases of the atmosphere have been found. These gases glowing under the action of the current passing through them, and not a metal heated to a white glow, produce the light.

An automatic starting apparatus has been developed which will light the tube seven seconds after the switch is turned. This necessitated the perfection of a heating unit that automatically turns off after the tube is lighted. Electrodes for the conduction of low current and a ballast coil which largely determines the power consumption and illuminating strength of the units were designed. The starting apparatus and ballast coil are required with each fixture, but they are small and inconspicuous.

AUTOMOBILE FATALITIES

MORE lives were lost in the United States during the last year and a half as a result of automobile accidents than in the A. E. F. during a year and a half of the World War, a survey by statisticians of the Travelers Insurance Company shows.

During 18 months of the World War 50,510 members of the A. E. F. were killed in action or died of wounds.

The American Naturalist

A Bi-Monthly Journal, established in 1867, Devoted to the Advancement of the Biological Sciences with Special Reference to the Factors of Organic Evolution and Heredity

JULY—AUGUST, 1930

Hydrogen Ion Concentration:

Hydrogen Ion Determination. PROFESSOR J. F. McCLENDON.

The pH Requirements of Cultivated Plants in Natural and Artificial Cultures. PROFESSOR EMIL TRUOG.

The Relation of pH to Plant Distribution in Nature. DR. HERMAN KURZ.

The Relation between pH and Aquatic Animals. PROFESSOR EDWIN B. POWERS.

The Ecological Determination of Twisted Hypocotyl and Other Peculiar Expressions in Hemp. PROFESSOR JOHN H. SCHAFFNER.

Shorter Articles and Discussion: A Possible Alternative to the Hypothesis of Selective Fertilization in *Sciara*: DR. CHARLES W. METZ. Chromosome Numbers in *Capsicum*: C. L. HUSKINS and L. LA-COUR.

SEPTEMBER—OCTOBER, 1930

The Evolution of Dominance in Certain Polymorphic Species. DR. R. A. FISHER.

Causes of Difference in Success of Reciprocal Interspecific Crosses. PROFESSOR W. P. THOMPSON.

Effect of Lecithin on the Sex Ratio in the Albino Rat. PROFESSOR H. E. JORDAN and W. H. PAINE.

Natica as a Radicle. A. L. MATHEWS.

The First Morning Song of Some Birds of Washington, D. C.; Its Relation to Light. H. A. ALLARD.

Shorter Articles and Discussion: Can Sex Ratio be Altered in Dioecious Plants?: R. C. MALHOTRA. Radiation and Genetics: PROFESSOR T. D. A. COCKERELL. Observations on Maternal Instincts of Birds. BASILE J. LUYET.

NOVEMBER—DECEMBER, 1930

The Significance of Sexuality. DR. W. E. CASTLE. The Problem of the Relationship between the Number and the Sex of Human Offspring. THE LATE PROFESSOR J. ARTHUR HARRIS and BORGHILD GUNSTAD.

Factorial Balance in the Determination of Fruit Shape in *Cucurbita*. PROFESSOR EDMUND W. SINNOTT and DOROTHY HAMMOND.

Some Problems in the Utilization of Inbred Strains of Corn. DR. R. A. BRINK.

Inheritance in a Mouse Species Cross. DR. C. V. GREEN.

Some Observations on the Biology of the Male *Drosophila melanogaster*. DR. F. N. DUNCAN.

An Attempt to Induce Mutation in *Drosophila melanogaster* by Means of Supersonic Vibrations. DR. A. H. HERSH, DR. ENOCH KARRER and ALFRED L. LOOMIS.

Shorter Articles and Discussion: The Theory of Dominance. DR. E. B. FORD. Meiotic Behavior of the Triploid *Oenotheras*. JOSÉ M. CAPINPIN. On the Influence of Temperature on the Process of Mutation. LEO FERRY, N. I. SHAPIRO and B. N. SIDOROFF.

Index to Volume LXIV.

JANUARY—FEBRUARY, 1931

Cyto-genetics and the Species-concept. PROFESSOR E. B. BABCOCK.

Cytological Evidence as to the Status of *Drosophila melanogaster*. PROFESSOR EDWARD C. JEFFREY.

Do Earthworms Grow by Adding Segments? KUO HUA SUN and KARL C. PRATT.

The Triple-tail, *Lobotes surinamensis*, its Names, Occurrence on our Coasts and its Natural History. DR. E. W. GUDGER.

The Influence of Ecological Factors on the Size of Population. DR. G. F. GAUSE.

Abnormal Herpetological Specimens from Syracuse, New York. PROFESSOR JULIAN D. CORNINGTON.

Shorter Articles and Discussion: A Mutable Miniature Gene in *Drosophila melanogaster*: PROFESSOR J. T. PATTERSON. A Case Demonstrating the Absence of Somatic Induction in *Drosophila*: DR. I. J. AGOL. Change in Color Pattern in a Captive Red Squirrel: ARTHUR SVIHLA. A Thumb Test for Distinguishing Mazzard and Mahaleb Rootstocks: B. R. NEBEL.

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THE SCIENCE PRESS

GRAND CENTRAL TERMINAL, NEW YORK CITY

During the last 18 months 50,900 persons were killed in automobile accidents in this country.

The 1930 total of deaths from automobile accidents was 32,500, the statisticians determined from reports of 40 states. This represents an increase of more than 1,200 over the 1929 total, although gasoline consumption dropped more than one billion gallons in 1930, with consequent reduction of mileage traveled by automobiles.

"Men were behind the wheel in 93 out of every 100 cars in accidents causing deaths and non-fatal injuries in 1930, with women being the drivers in the remaining seven," the records showed. "Whether the better record of women drivers as to fatalities is due to better driving, or not being behind the wheel for as many miles as men on the average, is not indicated."

In over half the fatal accidents, the drivers were between the ages of 25 and 54. In nearly a third more, the drivers were between 18 and 24 years. One half the automobile fatalities occurred in collisions with pedestrians, one fifth in collisions with other automobiles and about one tenth in collisions with fixed objects. Over half the non-fatal injuries were from collisions with other automobiles and one third of such injuries occurred in collisions with pedestrians.

The large number of motor vehicle fatalities can not be charged up to the automobile itself. About nine tenths of the killed and injured were victims of automobiles in good mechanical condition at the time of the accident. Most of the automobiles involved in these accidents were private passenger cars, though this class also represents most of the total motor vehicle registration in the country.

"Three specific driving violations by operators of automobiles were responsible, in whole or in part, for 68 per cent. of the 1930 accidents due to improper driving. They were exceeding the speed limit, driving on the wrong side of the road, and failing to grant right-of-way," the report stated. "Violations of driving regulations by motorists played a part in over two thirds of all the automobile accidents."

ITEMS

SCIENTISTS are now searching for a new basic unit weight of matter. Chemists have in the past used the atom of oxygen as the unit of atomic weight, calling it 16. Dr. F. W. Aston, of Trinity College, Cambridge, in a communication to scientists printed in *Nature*, has raised the point that since there are now three known varieties of oxygen atoms, known as isotopes 16, 17 and 18, the actual weight of the average atomic weight of the element oxygen is about 1.25 parts in 10,000 greater than the customary 16 assumed in chemical books. While chemists might get along with the present standard, Dr. Aston intimates, physicists who compare the weights of individual atoms by means of the mass-spectrograph with an accuracy of 1 in 10,000 need a new and more definite unit. Among the possible units suggested are: the proton or positive nucleus of the hydrogen atom, the neutral hydrogen atom, one quarter of the neutral helium atom, one sixteenth of neutral oxygen atom 16. But none of these proposed units is entirely free from objection.

FROM the astronomical observatory to the movie lot a new triple-fast photographic emulsion has come to make motion-picture production cheaper and more flexible. The motion-picture film introduced by the Eastman Kodak Company is described as "the greatest advance in motion-picture materials since the introduction of panchromatic film eighteen years ago." Its sensitive emulsion is very closely related to one prepared for astronomical photography which has been used to reduce the time required for making exposures through large telescopes. An improvement in the photographic plates used is just as effective in this case as though the telescope itself were increased in size. The super-speed panchromatic plates produced for newspaper photographers are also very similar to the new movie emulsion. When the movies went talkie it was necessary to banish the familiar arc lamps on account of their noise. Large incandescent lamps are used.

SAFFLOWER, which in its photographs looks to the layman something like a thistle without prickles, is one of the new plants being developed experimentally by the U. S. Department of Agriculture, for its oil-bearing seeds. The seeds contain a drying oil valuable in the production of paints and varnishes and allied products. The oil cake is useful as a stock feed. The plant is not really new, excepting in this country. For years it has been cultivated in India and Egypt as an oil-seed crop. Frank Rabak, of the Bureau of Plant Industry of the U. S. Department of Agriculture, under whose supervision experimental plantings of safflower have been grown, states that the crop is especially well adapted to the northern Great Plains region.

A SPONGE rubber pillow that sings and talks to an ear placed upon it is the latest product of a radio company here. It is intended for use in hospitals. A radio unit within the pillow is connected to a central radio receiver. So quiet is this type of installation that only the patient with his head on the pillow can hear the radio program.

A LONG-DISTANCE telephone call can now be made in less than half the time it took only five years ago. More specifically, the average time between the placing of a long-distance call and the commencing of conversation was seven and a half minutes in 1926; now it is two and a half minutes. This fact was brought out in a report presented by W. G. Harrison, of the American Telephone and Telegraph Company, and A. E. Silver, of the Electric Bond and Share Company, before the American Institute of Electrical Engineers meeting in New York. The two engineers also gave interesting statistics on increases in the use of both telephones and power. During the past decade while population has increased only 16 per cent. the number of telephone calls made each year has increased 96 per cent. and the annual kilowatt hour consumption of power, 107 per cent. In this period the mileage of telephone toll lines has increased 250 per cent. and of power transmission lines, more than 100 per cent.

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SCIENCE NEWS

Science Service, Washington, D. C.

TRANSMISSION OF TYPHUS FEVER BY FLEAS

For the first time the flea has been definitely incriminated as transmitting typhus fever in this country. Experiments proving this have just been reported by Drs. R. E. Dyer and L. F. Badger, of the U. S. Public Health Service.

Typhus fever in the Old World seems to be of slightly different type from the disease in the New World, and is transmitted by the body louse. It has been called jail fever and ship fever and was very prevalent in jails, crowded barracks and ships, city slums, and wherever people lived in congestion and filth. The disease has never reached serious epidemic proportions in the United States and for many years very few cases have been reported. The fact that the disease occurred in people who were not infested with lice led American investigators to suspect that some other insect was transmitting typhus fever in this country.

Drs. Dyer and Badger investigated cases of typhus which occurred on premises in the immediate vicinity of food-handling establishments in Baltimore in the late summer and fall of 1930. They found these premises heavily infested with rats. These animals were trapped and combed for fleas. About three dozen fleas were obtained from the rats and their nests.

The fleas were ground up and the emulsion injected into guinea-pigs, which contracted a disease like typhus fever. The clinical symptoms and the appearance of the organs and tissues corresponded with the symptoms and signs in pigs that had been inoculated with a strain of American or New World typhus fever.

Guinea-pigs which had recovered from an attack of endemic typhus produced by the New World strain were apparently immune to subsequent inoculation with the strain obtained from the flea emulsion.

Typhus fever is not to be confused with typhoid fever. The latter is caused by a bacillus, the former by a virus too small to be seen through the most powerful microscope. Typhus fever is transmitted by the bite of infected lice and fleas. Typhoid is transmitted by infected food, water or milk, and attacks the intestines chiefly. Typhoid fever is less often fatal than typhus fever. There is no known vaccine for typhus fever, while there is a preventive inoculation for typhoid.

PARROT FEVER IN NEW YORK CITY

DEVELOPMENT of five human cases of parrot fever, with one death in New York City, has just been reported to the U. S. Public Health Service. Dr. G. W. McCoy, director of the National Institute of Health of the Public Health Service, has gone to New York to investigate the outbreak, although the officer of the service on duty in New York has also been assigned to follow up contacts.

The disease has been traced to a shipment of six love birds which arrived in New York on January 4. Four

of these birds are now dead, one is under investigation at the Rockefeller Institute and the sixth has escaped. The human cases have all been traced to one bird.

Just a year ago, the U. S. Public Health Service banned the importation of any parrots, love birds or similar birds, following a severe outbreak of parrot fever. In October, 1930, this ban was modified so that birds could be imported subject to certain restrictions, among them a stay of two weeks in quarantine for observation. The six love birds in question were held for the two-week quarantine and no signs of disease were observed. Apparently they harbored the germ or virus of the disease, without being affected by it. Students of the question think that the change to a cold climate causes the development of the disease in birds that are infected. The six birds implicated in the present outbreak had not left New York City, although the whereabouts of the escaped bird are not now known.

No change will be made in the importation restrictions if no further outbreak occurs. Dr. Charles Armstrong, of the National Institute of Health, has been continuing his studies on parrot fever and will probably get a new strain of the causative virus for investigation as a result of the present outbreak.

SOUTH AFRICAN GOLD

At the end of 15 years the present gold mines of South Africa, which now supply over half of the entire world output, are expected to be near the end of their gold production, according to F. Lynwood Garrison, Philadelphia mining engineer, speaking before the American Institute of Mining and Metallurgical Engineers. The future production of the Witwatersrand's gold mines, said Mr. Garrison, depends on the possibility of mining and milling profitably the large tonnage of relatively low-grade ores known to exist in that area.

The director of the U. S. Mint, Robert J. Grant, presented figures showing that the production of new gold is mounting throughout the world following the decline that set in after the World War. Since the discovery of America, it is estimated that 40,000 tons of gold have been produced throughout the world.

In the production of new gold South Africa not only stands first just now, but in recent years has been far in the lead of all other regions. In the future economic development of the world, therefore, the South African supply of the standard metal is of paramount importance. During the next few years, African production will become even more important, despite the critical technical problems at present facing the gold industry of that continent.

Bankers joined with the engineers in discussing whether enough gold is being mined and whether the present business depression is related to the gold supply. The money users of the nation plan to join forces with the engineers in conserving the gold supply by devising

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Cloth, 8vo., 532 pp., \$5.00

The editors of this book have brought together information of value to students and investigators in the field of Protozoölogy that is at present either widely scattered in the literature or has never before been published. They have organized the work of approximately twenty-five outstanding research workers with the purpose of aiding both the seasoned investigator and the beginning student. The editors at first had intended to prepare the entire manuscript themselves, but it soon became evident that the work would be much more valuable if specialists in each field were to contribute chapters on problems and methods of research in the various phases of the subject about which they were most familiar.

HOOKWORM DISEASE

Its Distribution, Biology, Epidemiology, Pathology,
Diagnosis, Treatment and Control

By

ASA C. CHANDLER, M.Sc., Ph.D.,
Professor of Biology, Rice Institute, Houston, Texas; Recently
Officer-in-Charge, Hookworm Research Laboratory, School of
Tropical Medicine and Hygiene, Calcutta, India

Cloth, 8vo., 494 pp., \$5.00

"The book is well printed and illustrated, and must be regarded as a most important contribution, not only for research workers, but for general practitioners, especially those in tropical climates. It is written in clear style characteristic of the author. . . . He spent more than three years in India in full-time research on the various problems involving hookworm and hookworm disease. He covered all phases of the subject, and writes from personal knowledge as well as an extensive study of the work of others."—*American Journal of Public Health*.

PROTOZOAN PARASITISM OF THE ALIMENTARY TRACT

Pathology, Diagnosis and Treatment

By

Kenneth M. Lynch, M.D., Professor of Pathology, Medical College of the State of
South Carolina; Pathologist to the Roper Hospital, Charleston, S. C.; President,
American Society of Clinical Pathologists, 1930–1931; President, American Society
of Tropical Medicine, 1930

Cloth, 8vo., 258 pp., \$3.75

The confusion which exists among those practically concerned about Protozoa of the alimentary tract of man and their relation to disease has been the stimulus in writing this book. It was planned as a monograph for students and practitioners of medicine and for those variously connected with medicine in special ways which bring them as responsible parties into this very common consideration in diagnosis, prevention, and treatment of disease.

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methods of using less gold in their monetary dealings, according to Mr. George E. Roberts, vice-president of the National City Bank.

PETROLEUM IN THE UNITED STATES

AIRPLANE maps and shallow drillings in various parts of an oil field now enable geologists to predict the discovery of new wells, Dr. Sidney Powers, chief geologist, Amerada Petroleum Corporation, Tulsa, Okla., told the American Institute of Mining and Metallurgical Engineers meeting in New York on February 18.

In a paper on the occurrence of petroleum in the United States, Dr. Powers reviewed the most recent findings of geologists on the origin and place of occurrence of oil in the various states and the bearing of these facts on the further development of new or existing fields.

The important oil fields of North America, Dr. Powers said, generally occur on the saddleback folds of the rock strata, the "anticlines" in geological language. This is in sharp contrast to the complexity of many European oil fields. Geology, geophysics and the automobile have in the last twenty years cooperated in stimulating modern methods of discovery.

Most American geologists believe that oil is derived from organic matter deposited in sediments as slimes, oozes or water plant debris, together with animal matter, in relatively tranquil or stagnant water. Other residues from this same debris are now found lithified as shales or limestones.

The oil and gas after formation may move a little distance before being retained by some suitable reservoir rock surface. Sandstone and limestone, among others, are good reservoir rocks. The largest yields of oil from single wells have come from limestone caverns in Mexico and Persia.

A relatively small area of the United States is underlain by developed oil fields. One fourth of the total production of the country has been from Oklahoma, which has about 300 oil and gas fields, 3,000 gas wells and 61,000 oil wells. California is the other leading oil-producing state. The largest gas reserves are to be found at the Monroe field in Louisiana and the Amarillo field in Texas.

RICE ON THE FARM

THE rice-fed hog of bottomland farms may some day be a rival for his corn-fed brother who now rules the uplands. This is suggested by experiments on the lower midwestern floodplains, described by Professor W. C. Etheridge, of the University of Missouri, who was in Washington recently for a conference called by the National Research Council.

Rice, Professor Etheridge reported, has been successfully grown on a large experimental scale 60 miles north of St. Louis. Ten acres of rich bottomland under rice cultivation yielded 877 bushels. Some of the rice varieties tested ran as high as 125 bushels to the acre.

Feeding experiments on cattle and hogs were successful. Cattle did almost as well on a straight rice diet as they did on corn, and on a feed of rice plus corn they

put on weight as rapidly as they did on a mainstay diet of corn alone. With hogs, rice alone gave results equal to those obtained with corn alone. Of course, with all these flesh-making diets there were the usual additions of oilseed meal, alfalfa, or other protein foods, together with the necessary mineral and other diet accessories.

Professor Etheridge believes that we should begin to prepare now for a future in which farmers will slowly desert their present holdings on the hills and settle more and more on the rich but now largely neglected bottomlands. At present, cultivation of these lands is hampered partly by their frequent flooding, but mostly by our lack of knowledge of crops to grow there and the special methods of cultivation that will be necessary. He believes that by the use of machinery Americans can produce the immense crops that the Chinese get from lowland farms, but without the terrific amount of hand labor necessitated by the primitive agricultural methods employed in the East.

OBSERVING THE SUN'S CORONA WITHOUT AN ECLIPSE

A PROBLEM that has long engaged the attention of astronomers, that of observing the sun's corona without waiting for a rare total solar eclipse, has been partially solved by B. Lyot, an astronomer at the Meudon Observatory near Paris. He has reported to the Academy of Science how the form of the corona may be traced by the use of polarized light, provided the air is sufficiently clear. He made his observations from the 9,439-foot-high summit of the Pic du Midi, which was the first mountain to be used by astronomers for an observatory. However, this method does not permit actual photographs of the corona. To obtain these, astronomers must still wait until the dark disc of the moon covers the sun.

Ordinary light is made of waves vibrating in many directions, but when polarized the vibrations are mainly in one particular direction. Light may be polarized artificially by the use of special prisms, but it sometimes occurs in nature when sunlight is reflected from a cloud of small particles. The corona consists largely of such particles, so its light is largely polarized, a fact that has often been verified at eclipses.

M. Lyot's apparatus consists principally of a very sensitive polarimeter, that can detect one part of polarized light in a thousand times as much ordinary light. With a telescope lens he obtained an image of the sun, and screened the bright inner part with a metal disc the same size as the image. The glare thus eliminated, he was able actually to see directly the solar prominences, great flames of hydrogen and other gases that shoot out from the sun's surface. These also were first observed at eclipses. For many years it has been possible to observe them at other times with the aid of a spectroscope, but this is probably the first time that they have been observed directly.

With the polarimeter set a little way from the edge of the sun, about a fifth of its diameter, no polarization of the light was observed, but as the instrument was moved

SCHOOL AND SOCIETY

EDITED BY J. McKEEN CATTELL

CONTENTS

JANUARY 3

The Teacher as Cobbler: JOHN ADAMS.

Educational Events:

The London Schools; Revision of the Juvenile Statutes of Massachusetts; Safety Education; National Advisory Committee on the Education of Negroes; The Scholastic Rating System of the Massachusetts Institute of Technology; The Hubert Bequest.

Educational Notes and News.

Discussion:

1931 as a Centennial Year in the History of Education: WALTER CROSBY EELLS. *The So-called Honor System:* JOHN PALMER GAVIT.

Special Correspondence:

Mennonite Schools and Colleges: SILAS HERTZLER. *Subsidizing Scholarships:* OSCAR A. ULLRICH.

Quotations:

College Athletics.

Educational Research and Statistics:

Leadership in Curriculum Building in Large City School Systems: M. A. NORTON. *Constants and Variables in the High-school Program of Studies:* E. W. BAKER.

Index to Volume XXXII.

Educational Review, edited by WILLIAM MC-ANDREW.

JANUARY 10

The Future of the Liberal Arts College: R. L. KELLY. *A Brief History of the National University:* CARL W. TVEDT.

Educational Events:

The Study of Foreign Languages in the New York City Schools; Films and Exhibits of the Children's Bureau; The National Committee on Education by Radio; The Budget of the State University of Minnesota; The Dismissals from Mississippi Colleges; Officers Elected at the Cleveland Meeting of the American Association for the Advancement of Science; The North Central Association of Colleges and Secondary Schools; The Indianapolis Meeting of the Association of American Colleges and the Council of Church Boards of Education.

Educational Notes and News.

Discussion:

Sexagesimal Fractions: G. A. MILLER.

Special Correspondence:

Individualized vs. Group Instruction in the Sistersville, West Virginia, High School: R. B. MARSTON. *Comprehensive Final Examination Plan Adopted for Franklin and Marshall College Seniors:* ROBERT J. PILGRAM.

Quotations:

Student Activities in South American Revolutions.

Reports:

American Education during 1930.

Educational Research and Statistics:

The Ratio of Candidates for Eight Conservation Classes: J. E. W. WALLIN.

JANUARY 17

Native Education in South Africa—the Community Outlook: C. T. LORAM.

Who Shall Apply the Rod? ESTHER CRANE.

Educational Events:

The Children's Gallery in the Kensington Science Museum; Proposed Appropriation for Vocational Education; Military Training in the Schools; New School Buildings; Bequests and Gifts for Education and Other Public Purposes; The Dedication of the Student Union Building of the University of California at Los Angeles; The Victimization of New York City Teachers; The Eleventh Annual Ohio State Educational Conference.

Educational Notes and News.

Discussion:

The Minister's Degree: R. E. O'BRIAN. *Attributes Desired in College Instructors:* C. D. CHAMPLIN.

Special Correspondence:

An Experiment in Alumni Education through Evening Study at the Graduate Level: P. R. KOLBE.

Quotations:

Intellectual Cooperation.

Reports:

The Status of the Instructors in Public and in Private Junior Colleges: JOHN T. WAHLQUIST.

Educational Research and Statistics:

Student Honesty as Revealed by Reporting of Teacher's Errors in Grading: W. G. CAMPBELL.

JANUARY 24

Educational Books of 1930: JOSEPH L. WHEELER.

Psychological Studies of the Public Museum: EDWARD S. ROBINSON.

Educational Events:

Educational Broadcasts in Great Britain; Earnings of Students in Land-grant Colleges; "School Life" and the Educational Activities of the Government; The Use of Portable School Buildings in Baltimore; Budget of the Chicago Schools; The Indiana Conference on Child Health and Protection; Military Training in Land-grant Colleges; The Yale Curriculum; The American Association of Teachers of Physics; Junior High-school Conference; The Educational Research Association of New York State; The New York State Teachers College at Buffalo.

Educational Notes and News.

Discussion:

President Butler's Athletic Record: J. McKEEN CATTELL. *The Teaching of Civics:* RICHARD WELLING. *The Cost of Test Blanks:* PURCHASER.

Special Correspondence:

"Cultural" Mathematics at Antioch: J. D. DAWSON.

Quotations:

Teaching is Getting Better. President Hibben.

Reports:

Settlement of Professor Lough's Lawsuit against New York University.

Educational Research and Statistics:

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inward it began, and increased as the edge was approached. M. Lyot believes he has shown conclusively that this is not due to any effect in the atmosphere, because very light clouds completely eliminated the effect. He made a series of observations by crossing the sun at different angles, and was thus able to plot the outline of the corona in all directions. As photographs of the corona at eclipse time often show streamers extending many times the diameter of the sun, he has probably only recorded the inner corona, which is much brighter than the outer portions. Therefore, astronomers will still find it necessary to travel long distances to observe a total eclipse. As a full check on M. Lyot's researches, it will be desirable to observe the corona by his method at the same time that a total eclipse is being observed elsewhere. In commenting on his work, Dr. Henri Deslandres, director of the Paris Observatory, of which the institution at Meudon is a branch, suggests that it may be possible to photograph the corona without an eclipse with the assistance of the spectroscope from a suitably clear station.

The Pic du Midi, scene of M. Lyot's labors, was the first mountain observatory. François de Plantade, who was born at Montpellier in 1670, and was a colleague of the great French astronomer, G. D. Cassini, was the first to propose an observatory on the Pic du Midi in order to take advantage of the clear sky. He made several ascents to study conditions and died there in 1741 while making such observations. His work was the forerunner of the modern American observatories in California on Mount Wilson and Mount Hamilton.

Dr. George Ellery Hale, honorary director of the Mount Wilson Observatory, in 1893 made some of the first attempts to photograph the corona from a mountain top without waiting for an eclipse. These experiments were made from Pike's Peak, but were unsuccessful. It has been tried again in recent years, notably by Dr. W. H. Steavenson, a famous English astronomer, who conducted experiments in Switzerland in 1927, but these also were inconclusive. M. Lyot's method is based on a different principle from these, however, and it will be of great value if its accuracy is confirmed.

ITEMS

THE Copeland bill to establish a commission to study the need of a new engineering and industrial museum under the Smithsonian Institution has been passed by the Senate. If the bill gets through the House, nine men, including an engineer, an industrial chemist, a manufacturer, three men experienced in transportation by land, air and water, respectively, an educator, a labor representative, and a museum expert will report on exhibits of this character when the present arts and industries building of the U. S. National Museum is razed to make way for widening of a street in that vicinity.

THE bill providing for the establishment of a national park in the southern Everglades of Florida has been passed by the Senate and is now on the House calendar. Friends of the measure hope to see it enacted before

Congress adjourns, so that the work of acquiring the land for presentation to the U. S. National Park Service may go forward. The area is unique in that it shelters an almost unimaginable wealth of animal and plant life under tropical conditions and yet is easily accessible to thousands of persons of only moderate means and limited time for travel.

THE maternity and infancy welfare bill reported to the House by the Interstate and Foreign Commerce Committee is practically the same as the Jones bill which passed the Senate, and which had the approval of the U. S. Children's Bureau. The House bill, however, has a rider tacked on to it which sets up county health units for the U. S. Public Health Service. Miss Grace Abbott, chief of the Children's Bureau, by terms of both bills, will direct the maternity and infancy health work, and no time limit is set for the act to be in force. If the bill is passed by the House, and agreement is reached in conference with the Senate, so that final action is taken before March 4, the only way in which the work of the Children's Bureau can be curtailed in the future would be by withholding appropriations or repealing the law.

A FIFTY million-year-old whale skeleton, nearly complete and in excellently preserved condition, has been found in the San Rafael hills near Los Angeles. The huge skull, eight feet long, with its lower jaw in place and the whole perfectly preserved, together with a large part of the skeleton, has been excavated by J. W. Lytle, of the Los Angeles Museum, assisted by William Strong, H. A. Wylde and Lydia Bowen. It is now under preparation at the museum, where, because of its unusual completeness, it is regarded as a most important find.

THE proposed nine-foot channel for the upper Mississippi River will not only be a notable addition to the country's inland water-way system but it will also stabilize the resort industry in the famous lake region of northern Minnesota, if the theory held by Major-General Lytle Brown, chief of Army Engineers, is correct. It is a common occurrence now during a dry period in the summer for these lakes to suffer from a withdrawal of water into the river. As the water recedes, the shores are strewn with dead fish, and property values along these lakes decline. Major-General Brown believes the lake levels will be more apt to remain constant when the river attains a nine-foot depth than under present conditions. The deeper channel is being tentatively opposed by two Minnesota congressmen. These representatives from the northern part of the state say that they are not convinced that the levels of big resort lakes in their districts will not fluctuate greatly if War Department engineers maintain a channel depth of nine feet on the river. Major-General Brown is willing that legislation be introduced defining maximum and minimum levels for these lakes. He has also stated that the wild life refuges along the Mississippi shores will be five times as effective as at present, when a deeper channel is dug in the river.

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SCIENCE NEWS

Science Service, Washington, D. C.

SUN-SPOTS

THE sun-spots have recently been more plentiful. Telegraphic reports of observations made at Mount Wilson Observatory, California, received by *Science Service*, indicate that during the third week in February there were many sun-spots visible on the sun's disc as seen by the aid of the special solar telescopes there. Daily observations showed a peak of 28 spots in five groups on Tuesday, while on other days there were also many spots.

On the first day of February the sun was entirely free from disturbances although usually during the past few months there have been a few spots reported by the Mount Wilson Observatory.

The sun rotates on an axis from west to east just like the earth. The gigantic and complex disturbances in the outer layers of the sun which cause the spots therefore seem to pass across the face of the sun, sometimes reappearing some 13 days later after having travelled around on the other side of the sun.

Sun-spots occur in cycles with a maximum number appearing every eleven years or so. As the last maximum occurred in 1928 or 1929, it is now about half way between a maximum and a minimum. By 1934 the sun's activity should be quiescent.

The effect of sun-spots upon the earth has been one of the most active questions in astronomy for many years. There seems to be good evidence that spots, or the solar conditions causing them, in some way affect radio reception, magnetic disturbances, and that sometimes they put telegraphic lines out of commission by setting up earth currents.

Some spots are very large and visible to the unaided eye when the sun is viewed through heavily smoked glass. Others are very small, the smallest detectable being about 300 miles across. Some of the largest have measured 60,000 miles across. They may last for several months or they may disappear in a few hours.

A NEW PRECISION CLOCK

A NEW precision clock, which varies from correct time not more than one five hundredth of a second in twenty-four hours, has been devised by Professor Max Schuler, of the University of Göttingen. It is described in detail in *Die Umschau*.

The most distinctive feature about Professor Schuler's clock is the addition of a very considerable mass of metal to the upper end of the pendulum, so arranged that its center of gravity is exactly opposite the knife-edge bearing on which the pendulum is suspended. This makes for great steadiness in its swing, and is the principal contributor to the clock's great accuracy.

In order to prevent changes in length of the pendulum so far as possible, the clock is kept in a room in which the temperature is regulated, and any changes that do occur are registered on automatic apparatus. To reduce

atmospheric friction to a minimum, the clock is kept within a sealed glass case filled with hydrogen, which is the least viscous of gases.

The clock does not have a face and hands, like ordinary clocks. The function of telling the time is delegated to a second clock which it controls electrically, called a "slave clock." The free-swinging pendulum of this "master clock" does not even touch the electric contacts that drive the slave clock.

This is done by the most delicate and weightless of all possible levers, a beam of light. A lamp on one side of the master-clock case shines on a photoelectric cell on the other. Every time the pendulum swings, it causes a momentary eclipse of the photocell. This causes an electric current to flow for a moment, giving the slave clock the necessary little push to keep it going.

The "slave clock," thus admonished to accuracy from second to second, repays by closing a circuit with each swing of its pendulum, which supplies a momentary electromagnetic impulse to the master-clock pendulum, keeping it swinging.

X-RAY DETECTION OF DISEASE

DR. B. R. KIRKLIN and Dr. H. M. Weber, of the Mayo Clinic, Rochester, Minnesota, have announced results of new work in the X-ray detection of disease. Dr. Kirklin's work has been on the gall bladder and Dr. Weber's on the large intestine.

The X-ray picture, as is well known, is a shadow, cast in varying density, according to whether the rays can or can not pass through the tissues. The stomach, intestines, normal gall bladder and their normal contents, allow the rays to pass easily, and therefore do not cast good shadows on the X-ray film. Shadows of gallstones which would stop the passage of X-rays have been seen on films for many years. However, not all gallstones are satisfactorily opaque to X-rays.

The story of the development of methods for getting X-ray pictures of the gall bladder is a long record of brilliant achievement. Briefly, the method is as follows: The patient is given a harmless dye through which X-rays will not pass, and which is gathered up in the gall bladder; then pictures are taken at different intervals for a number of hours.

Using this method, until recently it has been considered impossible to distinguish between the shadows of gallstones of low calcium content and papillomas, which are little wart-like growths. However, Dr. Kirklin found a number of features that were characteristic of papillomas and not of gallstones. For instance the shadows of the papillomas were in the same position on all the films, whereas the shadows of gallstones might be in different places on different films; moreover, the shadows of papillomas were not immediately at the bottom of the gall bladder, whereas the stones would be likely to be there, like marbles in the bottom of a bag.

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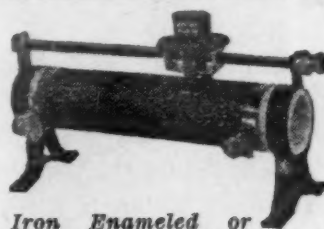
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There were, also, other characteristics. Four patients on whom Dr. Kirklin made the diagnosis were operated on, and papillomas were found, as he had predicted, in all four.

The method used by Dr. Weber in taking X-ray pictures of the large intestine was developed by Dr. A. W. Fischer, in Germany, and has been used also by Dr. J. Gershon-Cohen in this country in the X-ray diagnosis of tuberculosis of the large intestine.

It has been customary, in taking X-ray pictures of the large intestine, to give the patient an enema, in which is suspended some barium, a substance through which X-rays will not pass. Thus, a shadow of the barium-filled intestine is obtained, and deformities caused by disease can be seen. The method is good. However, it fails to disclose soft masses that do not cause deformity of the wall of the intestine, but merely project into its cavity.

The new method discloses such masses, including growths called polyps, in which Dr. Weber was particularly interested. The patient takes the enema, as in the old method, but expels it. Then, before the picture is taken, what might be called an air enema is given very carefully. The result is that the polyps, to the surface of which the barium has adhered, are outlined in the air-filled bowel.

To detect the presence of these polyps is important, since they have a tendency to develop into cancer. Also, Dr. Kirklin expects that his discovery that papillomas of the gall bladder can be detected will be extended to the detection of early cancers of the gall bladder. Cancers anywhere in the body, if they can be detected early enough, can be removed before they become dangerous.

CHILD HEALTH

GLANDS, vitamins and bacteria, and their rôle in the life of a healthy child were discussed at the recent meeting of the medical section of the White House Conference on Child Health and Protection.

Before the child reaches the stage of cod-liver oil and sunbaths, of diphtheria toxin-antitoxin or of possible thyroid gland disturbance, the glands, vitamins and bacteria have begun playing their part in making him healthy and strong or weak and susceptible to disease.

The female sex hormones and the pituitary gland have been the subject of much recent investigation. The facts on these vital subjects have accumulated so rapidly that medical opinion has not been able to evaluate them thoroughly and decide just what they mean.

"Additional experimentation and critical analysis of work already completed are urgently needed to clarify the general situation," according to the report of the committee which considered this phase of the situation. The chairman of this committee is Dr. Leslie B. Arey, professor of anatomy at Northwestern University Medical School.

Microbes are not all harmful, the committee pointed out. Some of the non-harmful group are those found normally in the intestines. These establish themselves shortly after birth and by fermenting sugars, produce

lactic acid which the committee called nature's preservative. This acid restrains the growth of disease-producing bacteria and adds much to the defense of the infant's vulnerable digestive tract. Along with this protection against intestinal infection goes resistance to respiratory infections, such as cold, bronchitis and pneumonia.

Vitamins begin playing their rôle of protection before the child is born. The vitamin content of the mother's diet has its effect both on mother and on child. Vitamins A, C, D and E are the ones particularly mentioned by the committee because of their importance to the mother's health and the child's development and future well-being.

INFLUENZA IN 1918

THE poorest people of the country were the hardest hit by influenza in the great pandemic of 1918, according to studies just completed by the U. S. Public Health Service.

At the time of that disastrous epidemic, some comfort was taken from the popular observation that the disease attacked rich and poor alike. The disease was very prevalent among all classes but analysis of the records shows that most cases of the disease and most deaths from it occurred among the poor.

"Apparently the lower the economic level the higher was the attack rate," Dr. Edgar Sydenstricker, statistician of the U. S. Public Health Service, reported. "This relationship was found to persist even after allowance had been made for the influence of the factors of color, sex, age and certain other conditions."

This report is based on surveys of 10 cities ranging in size from 20,000 to 500,000 and of several smaller cities and rural areas in Maryland. The families investigated were divided into four economic groups: well-to-do, moderate, poor and very poor.

"After making allowance for differences in the age distribution, it was found that the death-rate was the same in the two highest classes, was over 33 per cent. greater in the class denoted as poor, and was nearly three times as high among the persons classified as very poor." The case fatality rate, or number of deaths per 100 cases, was nearly twice as great among the very poor as among the well-to-do and those classified in moderate circumstances. Among the two lowest classes, there were more cases of influenza among infants and older adults.

The explanation of these observations is not clear. Crowded or congested living conditions among people of the lower economic levels has been suggested as one reason for the greater prevalence of influenza in these levels. The surveys did not support this theory.

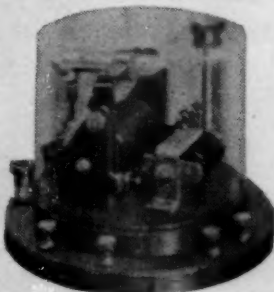
"Household congestion, although a concomitant of poverty, is not *per se* the determining factor in establishing the association of economic status and influenza in 1918," is the conclusion suggested by the studies, Dr. Sydenstricker said. The greater fatality among older and very young persons in the lowest level than in the higher economic classes suggests that their resistance, for some

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reason connected with their economic status, was lowered. More definite conclusions are not warranted because many conditions unobserved in the course of the survey may have been involved.

THE FLORIDA FRUIT FLY

THE Senate has passed a bill appointing a Mediterranean Fruit Fly Board to make a thorough investigation of losses suffered by fruit growers in Florida as a result of the campaign of eradication of the fly. The board would make its report, however, only for the sake of giving information to Congress. By terms of this bill its findings would expressly not be binding in any manner upon the Secretary of Agriculture and Congress.

In the second deficiency bill now before Congress, provision is made for making available the unexpended balance of last year's appropriation for fighting the fly, on condition that \$80,000 of it shall be available for research work in the Hawaiian Islands, Brazil and the West Indies, and that the remainder (about \$375,000) be set up as a reserve fund for use on order of the President, should there be further infestation of the fly which would make its use necessary. As is usually the case with a fund like this set up for a special purpose, if a year or two passes without need for expending the money, arrangements will undoubtedly be made to transfer it to another project.

Mr. Lee A. Strong, chief of the federal plant quarantine and control administration, told the House Committee on Appropriations that the last fruit fly infestation was found in St. Augustine on July 25, 1930. That, he said, proved that the fly could live over a full year, and once it lives over until spring, it can start a large population all over again very quickly.

THE LIFE OF BOOKS

THAT too much heat, certain gases, dust and improper lighting all tend to shorten the lives of volumes on library shelves, is shown by recent studies conducted at the Bureau of Standards of the U. S. Department of Commerce.

Cabinets in which the atmospheric conditions can be varied at will are being used in the experiments. Preliminary findings indicate that the drying out effect of heat is an important cause of the aging of paper.

Harmful effects of sulphur gases on paper are now being measured. It is thought that sulphur dioxide of the air is readily absorbed by paper and changed by chemical reaction to sulphuric acid which hastens the process of decomposition.

Sulphur dioxide in the air has been found to be an important factor in the sudden deterioration of clothing in laundries in some communities, where industrial plants involve the burning of quantities of soft coal. That sulphur gases may have a similar damaging effect on books in city libraries is suggested by the fact that the sulphur pollution in some industrial centers is known to be equivalent to a downpour of 100 tons or more of sulphuric acid per square mile.

As a means of lengthening the life span of books and

documents, the government investigators foresee a day when libraries will scientifically control the atmosphere surrounding their shelves. Regulating the heat and humidity, removing the dust and acid impurities from the air circulated in the library and minimizing the chemically active light rays permitted to shine on the shelves are suggested improvements for the future.

ITEMS

AN apparatus that will instantaneously "stop" a whirling electric motor for ten one millionths of a second, long enough to take a picture of it, and then "start" the motor just as quickly has been developed in the laboratories of the Massachusetts Institute of Technology. The new instrument is an improvement of the stroboscope, a type of apparatus that has long been used to study motion. Stroboscopic motion pictures, believed to be the first ever taken, have been made possible by the instrument. They were shown before the recent meeting of the American Institute of Electrical Engineers in New York last week. The unique feature of the new stroboscope is the electrical circuit which causes a condenser to discharge periodically through a thyratron mercury arc tube. An intense blue actinic light of extremely short duration, precisely timed to correspond with the speed of the machine under observation, is produced by a large current through the tube, and makes it possible to adapt the stroboscope for photographic as well as visual observation.

WHITE pine blister rust is such a menace to American national forests and timber stands in the Northwest that \$200,000 additional to eradicate currant and gooseberry bushes, which spread the disease, is in the first deficiency appropriation bill, which has passed both houses of Congress. This money will be immediately available to the Bureau of Plant Industry and the Forest Service. As this fight assumes national organization, the bureau will do considerable work, cooperating with individual timber owners and the states, while the Forestry Service will work mainly in the national forests and cooperate with the Bureau of Plant Industry. The agricultural appropriation bill also carries \$481,300 for blister rust control work by the Bureau of Plant Industry, as well as substantial amounts for the same purpose to be administered by the Forestry Service and the Plant Quarantine and Control Administration.

THE wild mice of deserts have learned to get along on less water than their relatives of moister regions. That, at least, is the indication of a discovery made by Dr. F. B. Sumner, of the Scripps Institution of Oceanography, and reported in the 1930 Yearbook of the Carnegie Institution of Washington, which has just been issued. He found that the water requirement, per unit of body weight, of desert-dwelling varieties of deer-mice is less than that of other varieties within the same genus that have a wider distribution, living in humid as well as arid habitats. The differences, which have been traced for several varieties, are hereditary.



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SCIENCE NEWS

*Science Service, Washington, D. C.*DISEASE LIKE ROCKY MOUNTAIN FEVER
IN THE EAST

EVIDENCE that dangerous Rocky Mountain spotted fever, or a disease very like it, occurs in states of the eastern seaboard as well as in the West, has been reported by Drs. R. E. Dyer, L. F. Badger and A. S. Rumreich, of the U. S. Public Health Service. The mystery of a number of cases of a strange and sometimes fatal disease which had occurred in these states during the last summer was simultaneously cleared up.

Rocky Mountain spotted fever is caused by a virus which gets into the blood by the bite of a tick. The first symptoms are chills and general discomfort. The fever may run as high as 107 degrees Fahrenheit. On or after the fourth day an eruption or spotty rash appears which is dark red and may become purplish. Pains in the bones, muscles, head and neck, and delirium are other symptoms. The disease lasts for several weeks. In some localities it is highly fatal. A protective serum has been developed by Dr. R. R. Spencer, of the U. S. Public Health Service.

In April, 1930, Dr. Dyer and colleagues began investigating cases of typhus fever which had been reported in some numbers from southeastern states. They soon found that there were actually two diseases, one typhus and one a similar disease which they believe is Rocky Mountain spotted fever. At least, the second disease can not be distinguished from Rocky Mountain spotted fever clinically.

They found that patients who had typhus lived in cities or towns, while the spotted fever patients, with only one exception, lived in the country. Most of the typhus patients had been in close association with rats and many remembered being bitten by fleas, probable typhus carriers, shortly before they became ill. Half of the spotted fever group had been bitten by ticks and the rest had lived under conditions in which tick bite was possible. The spotted fever cases, moreover, occurred at times which corresponded with the tick season, whereas the typhus cases were scattered throughout the year. No deaths occurred in the typhus group, but in the Rocky Mountain spotted fever group there were seven.

Dr. Dyer and his colleagues followed up the circumstantial evidence they had gathered in their field investigations. From blood of some of the spotted fever patients a virus was established which resembles closely the virus of Rocky Mountain spotted fever. One of the most conclusive bits of evidence was the immunity test. Animals and men that have had spotted fever once do not get it again, but are immune to it. The investigators found that animals that had recovered from Rocky Mountain spotted fever were immune to the strain isolated from the unknown disease of the southeast. Conversely, animals recovered from the unknown disease were immune to Rocky Mountain spotted fever.

Proof that this new disease in the southeast is Rocky Mountain spotted fever seems positive, but the investigators of the U. S. Public Health Service refrain from saying as yet, and call the new disease "an infection of the Rocky Mountain spotted fever type."

Until recently, Rocky Mountain spotted fever was believed to be confined to the Bitter Root Valley in Montana, where the wood tick that carries it is extremely prevalent. It is in this valley, also, that the disease is most often fatal. However, it has spread to Colorado, Idaho, Utah, Oregon, Nebraska, Wyoming, California, South Dakota, Washington and British Columbia.

In the East, the cases of endemic typhus investigated occurred in Baltimore, Savannah, Tampa and in smaller communities in Georgia and Florida. The Rocky Mountain spotted fever type cases occurred or originated in rural communities in Delaware, Maryland, Pennsylvania, Virginia, North Carolina and the District of Columbia.

THE RETIREMENT OF SENATOR RANSDALL

RETIREMENT from the Senate with the end of the present session of Senator Joseph B. Ransdell, Democrat, of Louisiana, marks a loss to science not easily compensated.

Senator Ransdell has been active in sponsoring many public health measures, most notable of which have been the establishment of the National Leprosarium at Carville, Louisiana, and the National Institute of Health now operating under the direction of the U. S. Public Health Service. In this institute, scholarships may be given to research workers in order that they may pursue research work in cancer, the common cold and other diseases, the control of which is of vast importance to mankind.

Senator Ransdell also introduced and pushed legislation which was recently enacted establishing a national hydraulic laboratory at the U. S. Bureau of Standards; and it was an amendment which he offered to a pending agricultural appropriation bill which first gave the U. S. Bureau of Plant Industry the means to work for the eradication of the pink bollworm. Flood control legislation has long been another subject upon which he has labored.

In his farewell speech to the Senate last week, Senator Ransdell chose for his theme: The Conservation of Public Health—the Most Important Problem Confronting Mankind.

Calling attention to the establishment of the National Institute of Health, Senator Ransdell said: "I can not suggest to the philanthropists of America, many of whom are seeking some wise use for their wealth, anything better than to contribute generously to this institute for the purpose of combating disease. Large sums are needed to place the institute on the solid foundation required for the colossal tasks ahead of it, and while Congress can be relied upon to do its part, the demands

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on the Federal Treasury are so heavy that I fear long delay for its full development unless private donors come to its relief." The Chemical Foundation Incorporated has made one contribution, and another one has been received from C. P. Wilder, of Worcester, Massachusetts.

Senator Ransdell's work was lauded at the close of his speech, by Senators Hatfield, of West Virginia, and Copeland, of New York, both physicians. Senator Copeland said that the United States lagged behind eight or nine other countries in the control of disease. The New York Senator also declared that every one should read particularly that portion of Senator Ransdell's speech which points out that any increased span of life now enjoyed in this country is due to the elimination of many childhood diseases, whereas men of mature years face prospects of death from disease exactly as menacing as those with which we were confronted fifty years ago.

MUSICAL CHORDS FROM ATOMIC VIBRATIONS

(Copyright, 1931, by Science Service)

THE musical vibrations of alcohol, water and gasoline and other common chemical substances have been written and played on the piano, by Dr. Donald H. Andrews, of the Johns Hopkins University.

The seductive chord of alcohol, for instance, is not the product of Dr. Andrews's imagination but represents accurately the various vibrations occurring among the atoms of the alcohol molecule and found in the Raman spectrum of its light. Thus the transposed music of the atoms can now be heard directly.

Of the substances tried up to this point, alcohol is first favorite with most listeners. Actually, with the exception of one note the seven notes of the alcohol chord form a well known harmonic combination. The tones of the chord may, of course, be broken up to give a melody or theme.

Interesting cooperations between the laboratory and the concert hall will result from this simple but provocative suggestion. Composers have already asked for the scores of these chemical themes. A chemical opera, said Dr. Andrews, can now be written in which the chemical chords can be used, "Christmas night" perfume will herald the heroine, arsenic the villain, water the coming rain.

On the other hand, the chemist with an interest in music will soon be looking more closely into his favorite songs and symphonies. Perhaps the stirring war song is a transposition of adrenalin—the substance that pours into the blood when he gets angry.

It looks as if some jazz orchestras had come near to imitating the melody of gasoline—for the gasoline music is a discordant combination of many unrelated notes. A similar effect might be produced by sitting abruptly on the piano.

Wood alcohol, in spite of its close chemical relationship to grain alcohol, has a harsh, sharp sound. Water is mysterious, pleasant without being sugary, like the

murmur of a waterfall in a deep glade. This music is derived from the light of these substances.

Light rays change color on passing through a substance. The amount of the change, discovered two years ago by Sir Chandrasekhara V. Raman, 1930 Nobel prize-man in physics, has been used by him and other scientists to measure the molecular vibrations.

Millions on millions more vibrations are made each second by the chemical substance than human ears can hear. However, Dr. Andrews has for the first time transposed the chemical music on to the piano, with these interesting results.

VELOCITY OF A NEBULA

ELEVEN thousand miles per second is the new record "apparent" velocity reported detected in the reddened light from a distant "island universe" viewed through the world's largest telescope on Mount Wilson.

The faint nebula discovered to seemingly recede from earth at this tremendous speed is so far distant that light traveling six trillion miles a year would need 120 million years to reach earth.

This new research result is said by Dr. John C. Merriam, president of the Carnegie Institution of Washington, to be "of special interest at this time because of Einstein's visit and the bearing that it will have on his conception of the universe." Dr. Walter S. Adams, director of the Carnegie Institution's Mount Wilson Observatory, reported the discovery to Dr. Merriam who announced it.

Milton L. Humason in photographing with the great hundred-inch telescope the spectrum of "the faintest nebula yet observed, discovered by a fellow astronomer, William H. Christie, observed that its spectrum lines were shifted to the red in such a way that a rushing away at eleven thousand miles a second would be necessary to produce it. This is sixty per cent. greater than any so-called apparent velocity so far observed.

But astronomers do not actually believe that the far distant cluster of stars is receding into space at any such tremendous velocity. They see the true explanation in the curvature of space, as postulated by Professor Albert Einstein, now at Pasadena, working with the astronomers who made the discovery. Space, he says, is curved in dimensions higher than the three familiar in everyday experience, just as a ball is curved in three dimensions. Very distant objects, like the nebula just discovered, give effects of great speed not because they are moving rapidly but because they are so distant that space gets a chance to produce its effects.

THE CRYSTALS OF THE URAL MOUNTAINS

LARGE ice crystals, up to eighteen inches across, can be found at only one spot in the world, at the famous Kungur ice-caves of the Ural Mountains.

Creeping its way along the chill subterranean passages, the expedition of the Hydrological Institute of Leningrad, led by Dr. W. Altberg and W. Troschin, gasped at the fantastic structures taken by water in these remote

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grottos. They returned with a priceless set of photographs to share their amazement with the scientific world.

Snowflakes, seen under the microscope as beautiful, delicate six-pointed crystals of very varied designs, will nevertheless not bear comparison with these strange Russian formations. Hailstones on very rare occasions have been found to consist of larger crystals, visible without magnification.

The cave crystals are not compact and solid. They are hollow, and six-angled, with a curious, spiral geometry. They show the intricate tropical forest effects of window-pane frost projected into three dimensions.

The odds against the coincidence of unusual physical circumstances necessary for the growth of large crystals to visible size are said to be enormous. Only at one other place on the earth's surface have they been reported and there not permanently.

The ice is deposited like hoarfrost by the cooling of moist air as it passes outwards through the caves. Those of the weird caves, so far explored, 22 in number, stretch in a nearly straight line for a distance of a kilometer. Measurements by the hydrological group showed that with a temperature outside of 40 degrees below zero the entrance to the first grotto, which contains much ice, was at 3 degrees Fahrenheit. The temperature rose steadily as the party passed inwards through the successive caverns, reaching as high as 45 degrees Fahrenheit above zero in the innermost cave. Under certain conditions a current of air passes from warmer to colder grottos, thus setting up the conditions for the deposition of ice.

The information obtained by the Leningrad party throws new light on the mode of formation of ice crystals and on the origin of ice caves.

THE POWELL MOUND

(By Science Service)

PREHISTORIC America had its periods of building activity, and perhaps, in between, its periods of depression. Evidence that no less than six different times Indians of this region organized their efforts to work on the great Powell Mound is the latest discovery made by archeologists who are now excavating the base of the ancient earthen monument at East St. Louis.

Examination of the site indicates that there was no very long gap of inactivity between the building of the six successive stages of the mound, according to a statement made to *Science Service* by Dr. A. R. Kelly, director of Illinois Archeological Explorations. The mound is definitely prehistoric and may well be at least one thousand years old, he said.

The Powell Mound, which is part of the famous Cahokia group of Indian mounds, is proving a strategic site for scientists who are writing America's pre-history. Explorations so far offer convincing assurance that Indians of Cahokia were linked culturally with Florida and the Gulf of Mexico to the south and also to the north with Wisconsin, Dr. Kelly said.

So significant are the contents of the mound considered that Dr. W. C. McKern, of the Milwaukee Public Museum, has come to East St. Louis to observe the excavations. He finds a marked similarity between the Indians here, as shown by their mound and its contents, and the mound-building Indians of Aztalan, in Wisconsin.

A link with the south is found in two species of shells in the Cahokia burials. These shells are from the Gulf of Mexico. Copper-covered wooden objects shaped like spindles and believed to be either ornaments or game pieces have been found in Powell Mound, and these are almost exactly like objects found in a Florida mound twenty-five years ago, it is recalled. To what extent the contacts of different Indian groups were by trade or migrations is not fully understood at present.

ITEMS

SUN-SPOTS decorate the sun in large numbers according to reports to *Science Service* from the Mount Wilson Observatory. On Thursday, February 26, there were 32 spots arranged in seven groups, while the day before there were 40 spots in six groups. Visitors to the National Academy of Sciences building, in Washington, were able to see many small spots spread over the image of the sun as projected within the rotunda of that building.

THE world's largest meteorite yet discovered is reported found by a Johannesburg land surveyor in the Tanganyika region of Africa. This record import from space consists of a mass of iron and nickel weighing some 70 to 80 tons and measuring nearly fourteen feet long. Its discoverer, W. H. Nott, staked a mining claim in order to obtain legal title to his discovery. The meteorite was found in open country about half way between Lake Nyasa and Lake Tanganyika. The newly discovered meteorite, which undoubtedly fell to earth many years ago, will probably exceed in size the meteorite that was found in the northeastern part of southwest Africa in 1928. This mass was then considered to be the largest actually discovered.

THE rubber planters of the Dutch East Indies, with profits depressed by the present low price of rubber, are seeking to recoup by extracting oil from seeds of the Para rubber tree. An item in the German scientific journal *Die Umschau* states that rubber-seed oil has in considerable measure the drying properties that make linseed oil valuable, and that it can compete to advantage with linseed oil, because it is at present about 20 to 25 per cent. cheaper. It is used in the manufacture of paint, linoleum and soap. Hevea, the Para rubber tree, is a botanical cousin of the castor bean, whose seed has long been a source of a widely used oil. Rubber-seed oilcake can not be used for cattle feed because it is poisonous. The planters therefore burn it under their boilers. Gathering the seed for pressing in the Dutch East Indies is made practicable through the low labor costs.

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SCIENCE NEWS

Science Service, Washington, D. C.

AGE OF THE EARTH

THE age of the earth is at least two thousand million years. This is the verdict of a committee of scientific men appointed by the National Research Council who have investigated, for the past four years, this basic problem of science.

The radioactive minerals uranium and thorium, which spontaneously disintegrate into lead, give the best clue to the earth's age. By carefully analyzing the radioactive minerals and their products in a sample of rock, it is possible to tell how long it has been in existence.

The oldest rock in the world, whose age has been determined in this way, is a piece of uranite or uranium-bearing rock from Sinyaya Pala, Carelia, Russia. It is 1,852 million years old and as it occurs in rocks that were intruded into the surrounding rocks, which therefore must be older, it is concluded that the age of the earth must be in round numbers at least two thousand million years.

Estimates of the age of the earth have been multiplied by more than twenty during the last three decades. The idea that the amount of salt in the ocean is an index of the earth's age was found by the National Research Council committee to be unreliable. Only a hundred million years can be accounted for by this method. This was a favorite figure for the earth's age at the turn of the century.

Professor Alois F. Kovarik, physicist of Yale University, and Professor Arthur Holmes, geologist of Durham University, England, explain in the National Research Council report soon to be issued the methods of age-determination based on radioactive disintegration. They are based on the fact that the radioactive elements uranium and thorium disintegrate spontaneously at constant determinable rates and yield lead whose atomic weight varies according to the proportion contributed by its radioactive parents.

The chairman of the committee was Professor Adolph Knopf, of Yale. Professor Charles Schuchert, of Yale, compared the radioactive age results with the evidence from the thickness of layers of the earth. Professor E. W. Brown, Yale, concluded that while there are no known astronomical methods the two-thousand-million-year age is consistent with astronomical probabilities. Professor A. C. Lane, of Tufts College, was also a member of the committee.

BIRDS THE FLIERS

THE ducks that wing their way northward through the March dawn, the hawks that hang and watch for a chance to pick one of them off, even the robins and blackbirds that flit across the lawns, are still more efficient flying machines than the best of man's inventions. They have better design, and they get more mileage out of a calorie of energy than any airplane now in existence or likely to be built.

This is brought out in a number of points in a study

of bird flight which has been made by Dr. Lucien H. Warner, of White Plains. His findings will be published in detail in the forthcoming issue of *The Quarterly Review of Biology*.

Birds have so reduced the weight of other body-parts that they can devote from one sixth to one half their total weight to the flying muscles, notably the big ones that form the breast of the bird and pull the wings on the down-stroke. In the pigeon these muscles weigh as much as all other parts of the bird taken together.

The streamlining of birds' bodies has long been noticed. It shares this low-resistance shape with fishes and other swimming animals, but has the advantage of smoothing out hollows and irregularities with almost weightless feathers instead of heavy flesh. Many flying birds tuck up their feet, being prototypes of planes with retractile landing gear, and those that are too long-legged for this trail their legs so as to make the least possible resistance in flight.

Highly efficient also is the utilization of food by birds, and its combustion in the tissues to produce energy. Analysis of food remains after digestion shows that birds assimilate much more of what they eat than do mammals. Their blood carries a higher number of red corpuscles per cubic millimeter, and therefore transports more oxygen to the final burning-places of dissolved foods, which makes for more efficient energy production.

Birds have a system of breathing peculiarly adapted to the needs of flying animals. The active part of respiration is exhalation, or breathing out. This is accomplished by compression of the ribs and breastbone, which surround the lungs. Thus the more rapidly the wings are moved, the greater the amount of air forced in and out of the lungs. A bird is thus less likely to get out of breath than is a mammal, which has a breathing apparatus quite independent of its movement muscles.

Dr. Warner also discusses the different methods of flight used by birds, and offers a new theory regarding the soaring flight of such birds as hawks and buzzards. It is his belief that such birds take advantage principally of the gustiness of the wind, adjusting themselves instantly to changes in its direction or force in such a way as to exploit its energy to gain additional lift.

TROPICAL DISEASE OF CATTLE IN THE UNITED STATES

CATTLE in portions of the United States, notably in the warmer states in the Southwest and along the Gulf Coast, have been dying from a tropical disease that probably invaded this country years ago but which has only recently been recognized.

Researches on the problem by George W. Stiles, Jr., of the U. S. Department of Agriculture, showed that the ailment is anaplasmosis, a disease prevalent in many of the tropical countries of the world. Cases in this country have been found in the following states: Ari-

they called it ptomain poisoning

. . . a name loosely used twenty years ago even by scientists and physicians, as well as the press. In 1923-25 forty necropsies were performed in fatal cases of "ptomain poisoning," and in every case the original diagnosis was disproved. This is one evidence of the rapid strides that have been made in this field of knowledge in the past decade. This progress in the solution of problems of food poisoning has been summarized by one of the country's leading bacteriologists.

FOOD POISONING AND FOOD-BORNE INFECTION

By EDWIN O. JORDAN

Included in this work are the important results of researches conducted by Savage, White, Scott, and others of the British Medical Research Council, of studies by members of the United States Public Health Service, of a series of investigations initiated and supported by the National Canners Association in the Universities of California, Chicago, Harvard, and Stanford. \$2.50

four fish live longer than one

If four fish are placed together in a bowl under toxic conditions the individual members of that group will live longer than single fish raised separately under similar conditions.

Other experiments with beetles, ants, bacteria, and spermatozoa lend added significance to this observation. During the past twelve years Dr. W. C. Allee has directed these experiments at the Whitman Laboratory of Experimental Zoölogy in an effort to determine what effects the communal life of animals exerts on individual members of the group; the results are summarized in

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zona, Florida, Louisiana, Texas, California, Nevada, Kansas, Oklahoma and Missouri. It is considered probable that it exists in other states as well.

The symptoms are so much like those of tick fever that cattle afflicted with anaplasmosis have undoubtedly been charged up to the score of the older and better known disease. There is an initial high fever, which does not last long, accompanied by a rapid, tumultuous pulse. The cow "gets poorly," "goes dry," and "loses her cud." There is a great loss of flesh. Severe anemia sets in, the red corpuscle count falling as low as one eighth normal. Between a third and a half of all cases end in death.

There seems to be no danger to human beings in handling anaplasmodic animals; so far as is known at present the disease attacks only cattle. Researches to date incriminate a number of species of tick as carriers of the infection, and point suspiciously, but without conclusive evidence, at a horsefly.

The disease is also transmitted in smears of blood on carelessly handled dehorning saws. It is strongly advised that all veterinary instruments be thoroughly cleaned and sterilized between uses on different animals, to eliminate this source of infection.

Anaplasmosis is caused by the attack of a microscopic animal parasite, known as *Anaplasma marginale*. This germ gets into the blood, multiplies and invades the red corpuscles. In mild cases only one per cent. or so of the corpuscles will show the dark spots that betray the presence of the parasite, but in severe cases from 25 to 50 per cent. will be affected.

Unfortunately, cattle that have had the disease and recovered continue to harbor the germs in their blood for a long time, thus becoming dangerous "carriers" of the infection.

THE FOOD OF PROTOZOA

THE smallest and most primitive of animals, the protozoa, like a balanced diet of mixed foods, no less than larger creatures that arrogate to themselves higher places on the evolutionary ladder. At least, that is what has been learned by three Stanford University investigators—Professor J. Murray Luck, Miss Grace Sheets and John O. Thomas, regarding one of the forms of minute animal life that swarm in stagnant water.

Protozoa, like the higher animals, have very diverse tastes. Some of them feed only on living microscopic plants—cows and sheep of the microscopic world. Others are carnivorous, accepting only other protozoa as food. Still others are carrion feeders, devouring dead micro-organisms.

The organism selected by Professor Luck and his associates was a plant-eater, feeding on bacteria, which are a low form of plant life. In order to start "at scratch," the Stanford scientists cleared their protozoa of the bacteria already in them, by a prolonged and difficult washing technique. Then the organisms thus sterilized were offered various kinds of bacteria to eat. It was discovered that they thrived little or not at all on several different species taken separately, but when

two or three kinds of bacteria were made into a "mixed ration" the protozoa grew fat and waxed very numerous.

It seems to be the living bacteria themselves that the protozoa want. In order to test a theory that they fed on some dissolved product of bacterial action, cultures of the protozoa were tried with broth in which bacteria had been grown and then removed by filtering or otherwise. But in these the protozoa failed to multiply, as they failed also in other kinds of food substances offered to them in solution.

The results of the three Stanford experimenters will be described in detail in the forthcoming issue of *The Quarterly Review of Biology*.

POLAR COLD SEEN AS AN AGENT IN THE DISTRIBUTION OF ANIMALS

ICE and the cold winds and snowstorms that blow from the face of glacial regions have been the great shepherds that arranged the world's present distribution of animal life.

This was the belief of the late Professor W. D. Matthew, of the University of California, as expressed in a contribution sent to the international scientific journal, *Scientia*, just before his death.

Looking at a globe, or at a non-distorted map of the world, Professor Matthew saw that the continents tend to bunch together at the northern "end" of the earth, with their southern tips stuck down prongwise and far apart. During the warm climatic phases which are really the normal state of world weather in the geological time sense, animals can travel about very freely in this great northern land zone, and flourish near the North Pole.

Then, when some hundreds of thousands of years of stiff winters come on, with perhaps an ice age to climax the matter, all but the very hardiest of them must move southward or perish. So long as the barrier of ice or of persistent cold weather stands against them, "East is East, and West is West, and never the twain shall meet." American animals evolve in America, Asiatic in Asia—and there is no intercontinental traffic.

Professor Matthew held that this cycle of free intercourse, followed by blockades of cold, repeated itself several times in the earth's long history. Each time it happened, it started a new series of southward migration waves, and at the same time the disturbances and hard times forced a speeding-up in the evolutionary process. So that the ice was not only a great shepherd but a great animal breeder as well.

THE CORRECTION OF CROSSEYES

A NEW method of correcting crosseyes or squint, scientifically termed strabismus, has been devised by Dr. Ernest E. Maddox, of Bournemouth, England, who recently reported his results to the Royal Society of Medicine. The new method does not claim to replace the old ways of correcting strabismus by glasses, prisms, or operation, but supplements them.

Dr. Maddox suspected that many of the more incurable cases of squint are due to persistence of the infantile



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inability to coordinate the movements of the two eyes. He has developed an apparatus designed to discourage the tendency of each eye to do business on its own account instead of in partnership.

The principle which he employs is the use of the hand of the squinter to educate his squinting eye, imitating the natural process of infancy in which the hand and eye mutually perfect their training by trial and error.

This new instrument, the cheiroscope, takes its name from two Greek words meaning "hand" and "look." It is similar to the familiar stereoscope, but whereas the stereoscope is held in the hand and the eyes look straight forward at a picture placed in a carrier opposite the lenses, the cheiroscope is tipped so that the lenses are above a horizontal tray surface which replaces the picture carrier and on which the child can play or draw. The child looks down on the tray and a vertical plane divides the field of vision.

If a bead is placed on the tray beneath one eye, a ring on the other half of the tray seen by the other eye will appear surrounding the bead or may be so placed by the child. On the theory that left hand and left eye work together, as do right hand and right eye, the hand on the side of the poor eye is kept busy.

The eye belonging to the hand is tempted to the spot with which the hand is occupied and does its best to help it, even though it only wakes up to do so gradually, while at the same time the surgeon learns what the child's brain is doing by watching the hand.

It is all a game to the child. A fierce open-mouthed lion on one side can be fed by red beads on the other. The picture of a pretty little girl on one side can have a bead necklace constructed round its neck by the child, one eye all the time seeing the little girl, the other the beads.

There are modifications of this apparatus used for different degrees and types of squint. Dr. Maddox points out that there is no reason why the "hand and eye" principle should not be turned to account with an ordinary stereoscope. Here a finger on the side of the amblyopic eye must point out details of the picture and the trick of this procedure is to prevent the finger from traveling across the mid line to the picture in front of the good eye. Dr. Maddox promised that with perseverance and concentration squint training will bring results.

ITEMS

WHEN caterpillar tractors were introduced recently on Santa Rosa and Don Martin, two islands off the coast of Peru, to take the place of hand guano mining, the bird population welcomed the machines in so whole-hearted a manner that they were operated only with the greatest difficulty. The birds, known as guanayes, marched in such numbers before, behind and alongside the machines that they could scarcely be moved. The guanaye, or Peruvian cormorant, inhabits the islands in the Humboldt Current off the coast of Peru, which islands for a century provided the world with the fertilizer known as guano. In Incaic times, the guanaye was rigidly protected by law from molestation. Until recently no motor

vehicle or airplane was permitted on or near the island homes, lest the guanayes be frightened.

THE elk and deer in Platt National Park, Oklahoma, refuse to stay in their paddocks, but, having got out, they also refuse to stay out, according to Superintendent William E. Branch. Part of the park is used as a game preserve by the Biological Survey, and deer, elk and buffalo are kept in fenced-in pastures. Recently all the white-tail deer leaped over their paddock fence and roamed the country for several days. They soon returned, however, of their own account. According to Mr. Branch this happens frequently, as the deer can leave at will. They always come back the way they left, by jumping the pasture fence. The elk also get restless occasionally, and sometimes get out of the paddock. They, too, always come back. The buffalo seem quite contented and never attempt to leave their paddock, although it is fenced with ordinary cow pasture fencing.

INSECTS that survive from one warm season to the next, sleeping through the winter like bears, prepare for the winter very much as bears do, by increasing the body store of fat. They further insure survival by getting rid of as much water as possible, making their body fluids difficult to freeze to the point of crystal formation, which would have fatal effects. Hibernating insects will freeze to death if their environmental conditions are disturbed, whether they are prepared for the cold or not. These are, in skeleton outline, the results of experiments by N. L. Sacharov, of the Agricultural Experiment Station at Saratov, U. S. S. R. They are set forth in a full technical paper in English in the American scientific journal *Ecology*.

STUDIES upon the compositions of the blood of different animals which have just been completed at Cornell University show that the blood of the lower forms such as fish and turtles contain nearly three times as much phosphorus as those of the higher mammals. Fish have long been reputed to be high in phosphorus but the various forms in the blood have not been studied previously. Most of the phosphorus of fish blood is concentrated in the red cells. This high phosphorus value for fish blood is interesting in the light of the meat diets used for rearing trout in most hatcheries. Brook trout grow to maturity upon food that is very rich in phosphorus, such as beef liver. One might expect bloods rich in phosphorus among the carnivorous fish but not among the omnivorous, such as carp. The bloods of both pike and carp were analyzed, however, and found to be equally high.

FOUR years afloat is the record of a bottle tossed overboard by Captain G. Gellanders, of the British steamer *Burmese Prince*, on December 8, 1926, and picked up recently among the Bahamas. The paper in the bottle gave the latitude and longitude of its launching, which showed that it had drifted probably about 6,000 miles. The find was reported by the Hydrographic Office of the U. S. Navy.

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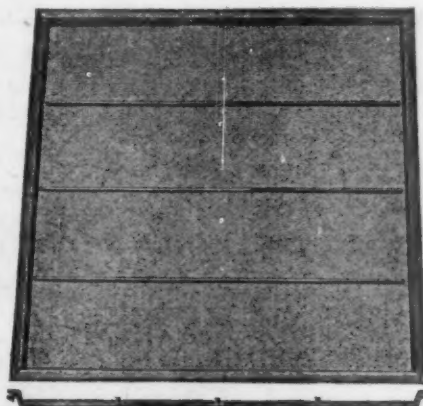
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SCIENCE NEWS

*Science Service, Washington, D. C.***SUNSHINE AND COD-LIVER OIL FOR THE PREVENTION OF CONVULSIONS**

INFANT deaths in America due to convulsions would be reduced by half if all babies were given the doses of cod-liver oil and sunshine required for proper growth, Dr. Martha M. Eliot, director of the child hygiene division of the the Children's Bureau of the U. S. Department of Labor, is convinced from her research in the community control of rickets.

One kind of infantile convulsions, called tetany, is associated with severe cases of rickets, which is prevented by ultra-violet radiation of the sun and by cod-liver oil.

Practically no cases of rickets occur in Porto Rico, where there is an abundance of sun and the houses have no windows to keep the ultra-violet rays from shining on the babies. In northern sections of the United States where the sun does not shine brightly and children are kept indoors most of the time, rickets is frequent and serious, particularly among children whose forebears came from the sunny climes. Negroes and dark-skinned children of southern European descent suffer most severely from lack of sunlight.

An experiment conducted by Dr. Eliot, at New Haven, proved that entire communities in this northern region can be almost entirely freed from rickets, however, if babies are given sun treatments and cod-liver oil. For centuries cod-liver oil has been recognized as a good medicine for children, but only recently has it been known that it contains vitamin D, the same vitamin that is formed in the skin by the action of the sun's rays.

A mixed section of New Haven, including some Negro and southern European families, was selected for the study because of the susceptibility of dark-skinned babies to rickets. Whenever a baby was born, a nurse from the clinic visited the home and explained the treatment. The mothers were shown how to make their infants swallow the cod-liver oil, which should be taken daily after the child is five days old. When the babies were old enough for sun baths, the mothers were instructed how to give the child his dose of sunlight, out of doors if the weather were fine, or by an open window, during the winter.

Monthly examinations of the babies subject to this treatment over a period of three years indicated that only 27 out of the 480 babies born in the community during that time developed moderate or severe cases of rickets and in all 27 cases the mothers had failed to follow the nurse's instructions. X-ray pictures of the children's bones revealed that a greater number at one time or another had the beginnings of rickets, but that these were quickly outgrown and apparently had no harmful effects.

GERMS KILLED BY SOUND WAVES

AUDIBLE sound waves, high-pitched and intense, have been used to kill bacteria by Professor O. B. Williams,

of the University of Texas, bacteriologist, and Professor Newton Gaines, of Texas Christian University, physicist.

Sound waves of much higher pitch, so high as to be wholly inaudible, have in the past been used with fatal effect on living things, the pioneer experiments in this field being performed at the private laboratory of Alfred L. Loomis, banker-scientist of Tuxedo Park, New York. But the Texas experiments were the first in which audible sound waves were shown to be effective.

Professor Williams and Professor Gaines produced their sounds by means of a nickel tube, caused to vibrate at the rate of about 8,800 oscillations per second by means of powerful electromagnetic coils wound about its lower end. The oscillating current was supplied through two 250-watt radiotron tubes, such as are used in radio broadcasting stations, carrying a plate voltage of about 2,000.

The upper end of the tube was set in an inverted bottle and surrounded with water. When the current was turned on, the vibration was so intense as to cause a little mound of water to rise a couple of inches above the surface.

A flask, containing the bacteria to be "rayed," was lowered into this turbulent water mound. The sound waves passed through the glass into the fluid containing the germs, causing a disturbance similar to that which was raised in the water.

Bacterial cultures "rayed" for 10-, 20-, 30-, 40-, 50- and 60-minute periods were compared for numbers of survivors. It was found that a definite mathematical relation exists between the time of exposure and the number of survivors. At the end of one hour in the field of the waves there were less than half of the initial number of bacteria left alive in the flask.

The waves have also been tried on red blood corpuscles and have been found to be destructive to them. This is in line with similar experiments performed at Tuxedo Park, where supersonic waves of ten to a hundred times the frequency were used.

NARCOTIC DRUGS

A CAMPAIGN to limit the use of narcotic drugs to legitimate medicinal needs has been launched by the organized medical profession of the country. The campaign has as its object the two-fold purpose of reducing the extent of drug addiction and of forestalling legislative restriction of the individual physician's use of narcotic drugs.

Beginning with the current issue, the American Medical Association will issue in its *Journal* articles dealing with various phases of the narcotic drug problem. The effect of such drugs on the body, methods of treating drug addiction, indispensable uses of narcotics in medicine and surgery, substitution of non-habit-forming drugs for ones with addiction properties, and progress of research for a non-habit-forming substitute for morphine are the subjects of the series planned.

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The editor of the *Journal* states that "It is the purpose of this series of articles to indicate to the medical profession the relatively few instances demanding the administration of opium or cocaine derivatives and the many substitutes therefor that may be available.

"Something under 25 per cent. of narcotic addiction, it is estimated, results from the beginning of the habit through previous use of drugs in medical treatment. This is after all only an estimate, based largely on evidence derived from the addicts themselves, who are notoriously an unsafe source of evidence.

"Nevertheless the physician must strive to limit his prescribing of narcotics absolutely to those situations in which the narcotic may be considered indispensable. Thus he will avoid the possibility of unfavorable criticism."

In addition, the American Medical Association declares itself ready to aid in every possible way state medical licensing boards in their efforts to purge the medical profession of those who have any conscious part in the creation and maintenance of narcotic addiction. It states that "Their activities reflect unfavorably on a profession of high standing and it will not tolerate them in its midst."

THE DETECTION OF MUSTARD GAS

YPERITE, or mustard gas, is now being combated by the German chemist who, perhaps more than any one else, made chemical warfare an effective part of modern battle.

A touch of drama is added to the search of the International Red Cross for an effective means for detecting mustard gas in small atmospheric concentrations, by the presence on its jury of awards of Dr. Fritz Haber, of Berlin-Dahlem. A prize of 100,000 gold francs has been offered for the most efficient detector, and tests of about a score of entries will be made in Paris soon.

Associated with Dr. Haber will be a brilliant group of scientists representing nations formerly enemies of his own, as well as one neutral power. They are Sir William Jackson Pope, professor at the University of Cambridge, England; Professor M. F. Swarts, of the University of Ghent, Belgium; Professor M. G. Urbain, of the Sorbonne, Paris, and Professor H. Zangger, of the University of Zurich, Switzerland. Dr. L. Demolis, technical counsellor of the International Red Cross Committee, will act as secretary of the jury.

In the near future the International Red Cross Committee hopes to organize two similar competitions, one for the best anti-gas mask and the other for large-scale shelters against poison gas. The organization of competitions of this kind is in line with the campaign for the protection of civilians against chemical warfare which the International Red Cross Committee is conducting and in connection with which it has brought about the formation in a number of countries of mixed commissions composed of chemists, doctors, technicians, representatives of the government and of the Red Cross, to work out methods of defense.

Yperite has been termed the "most formidable weapon of aggression" because of its unusual character-

istics of permanence and insidiousness. Mere contact with the soil or contaminated objects as much as two or three days after the attack is sufficient for a good case of being gassed. An odor of mustard is all that, at first, tells the tale. It is only after four to six hours that the victim begins to feel the effects—temporary blindness, suffocation, burning and blistering from the gas that penetrates all ordinary clothing. This retarded action is due to the fact that yperite is projected not in a gaseous state but as droplets.

To date yperite has eluded all attempts at mastery. The gas mask had, by 1918, been perfected to the point of protecting the wearer against all chemical warfare gases. Yperite, however, requires special protective clothing as well as a gas mask. Although many detectors were used during the war, none was completely successful in finding the whereabouts of the elusive mustard gas. The ideal detector is still being sought. It must be sensitive enough to signal even a feeble trace of the gas; and function rapidly enough to give time for self-protection. It must be easily handled and sufficiently inconspicuous for placement in front of the lines if necessary. Finally, it should be able to detect all the various gases used in chemical warfare.

ACIDITY OF SOILS

THE higher the sourer seems to be the rule regarding soil reactions. Confirming by researches in the richest forest region in eastern North America the observations of other investigators in various parts of the world, Dr. Stanley A. Cain, of Butler University, has collected a considerable series of data from the Great Smoky Mountains region in Tennessee and North Carolina, which is to be developed as the greatest of the U. S. National Parks in the East.

Starting with a moderate degree of acidity in the valleys, Dr. Cain found that the soil became more and more sour as he climbed the mountains, reaching the summits and the highest acid concentrations at the same time. The soil reaction was correlated with different types of vegetation: beech and oak-chestnut forests in the lowlands, laurel "slicks" and other heath types, together with pine woods on the middle slopes, and at the higher elevations thick growths of spruce trees standing in a deep carpet of sphagnum moss. The most acid soil was found beneath the "heath balds" that crown some of the mountains.

Many factors conspire to make acid soil in the Great Smokies region. The underlying rocks are geologically very old, of types that weather into non-alkaline soil. There is a great deal of rain and low evaporation rates, which tends to keep the ground wet all the time. The growth of dense vegetation is favored by a mild climate, yet the temperature is low enough so that fallen leaves and dead moss decay very slowly. All these factors tend to have a cumulative effect, producing a highly developed, beautiful but botanically very peculiar type of vegetation.

SPRING WEATHER

SPRING will arrive early in the eastern United States, Professor Charles F. Brooks, of Clark University, pre-

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diets on the basis of a recently discovered relationship between winter temperatures in Winnipeg, Canada, and spring temperatures in the eastern states.

Fred Groissmayr, a meteorologist of Passau, Germany, last year published in *The Monthly Weather Review*, the official publication of the U. S. Weather Bureau, data showing that March and April temperature in the eastern United States is usually indicated by the January-February temperature at Winnipeg.

Professor Brooks has compiled the daily maximum and minimum temperatures at Winnipeg from daily weather maps and finds that the temperature was 14.2 degrees Fahrenheit above normal in January and 19.0 degrees above normal in February, an average of 16.6 degrees above normal for these two months of 1931. In only one year in the period of record has Winnipeg had a warmer January and February combined.

Fifty years of weather records show that by multiplying this excess over normal temperature at Winnipeg by the factor 0.227, the expected departure from normal temperatures in a group of eastern U. S. cities can be obtained. This computation carried out indicates that the March-April temperatures will be 3.8 degrees above normal. Dr. Brooks therefore expects a warm March and April and an early spring.

Mr. Groissmayr, the German meteorologist, explains this correspondence between winter Winnipeg temperatures and spring eastern U. S. temperatures as being due to the lack of chilling of air passing over the Lake States during a mild winter. Reports indicate that this winter has been the most open season on the Great Lakes ever recorded. Winds passing eastward are therefore likely to be warm as there is no great area of ice to chill them.

ITEMS

RADIO reception has been noticeably impaired coincidentally with the appearance of plentiful spots on the sun, Dr. Harlan T. Stetson, director of the Perkins Observatory, Ohio Wesleyan University, has observed. Previous to the recent rise in sun-spots, radio reception was the strongest recorded in several years of research undertaken by Dr. Stetson and his colleagues. The recent rise in sun-spots reported by Mount Wilson Observatory in California was anticipated by Dr. Stetson on the basis of the 15-month cycle in spots that he recently discovered. The increase arrived exactly on schedule. Dr. Stetson expects the sun-spots to decrease after about April 1 and then radio reception will become as good or better than it was before the present sun-spot outbreak.

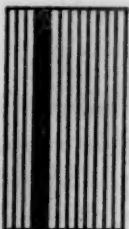
BERLIN visitors passing through the Natural History Museum in Berlin will have an opportunity to see a huge dinosaur skeleton from Africa, which has just been set up. It represents a beast similar to the American dinosaurian genus *Diplodocus*, though it is not quite so large. As the skeleton stands in the museum, it measures about 41 feet in length and just under 10 feet to the highest part of its arched back. It is known as *Dicraeosaurus*. The skeleton was collected by a recent German expedition to the Tendaguru region in East Africa.

THE U. S. Geological Survey has been informed that the first commercial shaft ever sunk in the United States for potash has now reached a depth of a thousand feet, and potash minerals are ready to ship. The shaft has been sunk by a firm formed to develop the great potash fields in Texas, recently explored by the survey. After government investigators had put down about twenty test holes the company drilled an equal number, and then began sinking its shaft. This has now passed through several workable beds of potash minerals, the best of which consists of a salt known as silvite.

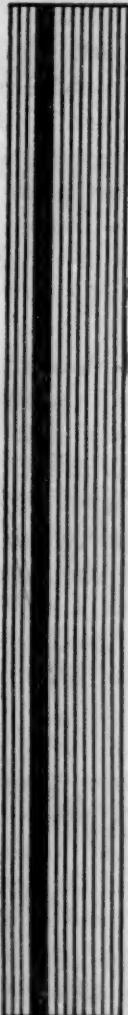
WHEN optical lenses must be ground accurately to within five or six millionths of an inch, the temperature in the work-room should not be shifting from 70 to 85 degrees, or down the scale to 65. Vibrations make a great deal of difference, too, and dust flying about can wreck havoc with one of those millionths. However, for ten years opticians at the U. S. Bureau of Standards have had to do their work in the industrial building, where dust, noises, vibrations and temperature changes have been frequent. Dr. C. A. Skinner, chief of the optics division, recently announced that early in 1931 the new underground optical laboratory will be ready for use. Dr. Skinner explains that the layman can perhaps understand the importance of tiny, accurate measurements, when he realizes that a first-class telescope lens must concentrate every beam of light from a distant source, such as a star, within an area so small that even when magnified 500 times or more the eye can perceive nothing but a point. Moreover, the final figuring in grinding optical lenses has to be done by hand, for machinery is incapable of such fine work.

LIVER extract is a fairly good source of the anti-pellagric vitamin G, and consequently would be of value in large quantities in the treatment of pellagra, the U. S. Public Health Service has reported. This finding was the result of investigations on dogs who suffer from a disease similar to pellagra in humans. The study was begun under the direction of Dr. Joseph Goldberger before his death and was carried out by Dr. W. H. Sebrell, of the service. The liver extract used was developed by Dr. George R. Minot, of Harvard University, who with Dr. George H. Whipple, of the University of Rochester, recently was awarded a \$10,000 prize for achievement in the solution of the problems of simple and pernicious anemia.

It doesn't seem to make much difference to an insect which way its heart beats. Its heart is a reversible organ, sending the blood backward as readily as it propels it forward. Professor John H. Gerould, of Dartmouth, has been watching the hearts of crane flies, those long-legged creatures we sometimes mistake for over-size mosquitoes. Describing his observations before the meeting of the American Society of Zoologists he said that on the average a crane fly heart would beat in the forward direction 63 times, then backward 36 times.



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SCIENCE NEWS

Science Service, Washington, D. C.

KNOWLEDGE OF PAST AND FUTURE IN
QUANTUM MECHANICS

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PROFESSOR ALBERT EINSTEIN has concluded that past events of any sort can not be described with precise certainty. This extension of the principles of the new physics is contained in a letter to the editor of *The Physical Review*, journal of the American Physical Society. Professor Einstein, jointly with Professor Richard C. Tolman and Dr. Boris Podolsky, of the California Institute of Technology, wrote this communication just before he left Pasadena to return to Germany. The issue of *The Physical Review* containing the letter will be distributed in a few days.

Not only does Professor Einstein conclude that there is an uncertainty in the description of what has happened in the submicroscopic world with which the most recent theories of physics usually deal. He applies this disconcerting principle of uncertainty to such every-day happenings as the opening and closing of a shutter on a camera. We can not know exactly just when a shutter opens or closes.

Professor Einstein and his two colleagues write: "It is of special interest to emphasize the remarkable conclusion that the principles of quantum mechanics would actually impose limitations on the localization in time of a macroscopic phenomenon such as the opening and closing of a shutter."

The idea that it is impossible to predict the exact path of an object in the future was advanced some two years ago by a young German physicist, Professor W. Heisenberg. This principle of uncertainty has had an influence on the philosophy as well as the practice of science comparable with the idea of relativity introduced by Dr. Einstein.

As the opening paragraph of the Einstein-Tolman-Podolsky letter states: "It is well known that the principles of quantum mechanics limit the possibilities of exact prediction as to the future path of a particle. It has sometimes been supposed, nevertheless, that the quantum mechanics would permit an exact description of the past path of a particle."

Professor Einstein laid one of the foundations of the quantum theory, building on the work of Professor Max Planck. The Einstein classic paper of 1905 applied the quantum theory of energy to light and electricity. The quantum idea that energy is not continuous but in packets or gobs like matter has been one of the most fruitful conceptions of the new physics.

Now Professor Einstein adds the latest building block to our conception of matter and energy by telling us that the past as well as the future is uncertain.

Professor Einstein's associates in his new pronouncement are on the staff of the California Institute of Technology at Pasadena, where he worked during his recent stay in America. Professor Tolman is one of

the leading authorities on thermodynamics. His theory of a non-static universe replaced the Einstein theory of the universe. Dr. Podolsky is a young physicist, Russian-born but now an American citizen. He was a National Research fellow in physics for several years.

The title of the letter to appear in *The Physical Review* is "Knowledge of Past and Future in Quantum Mechanics."

VIBRATIONS OF THE NUCLEUS OF THE
ATOM

VIBRATIONS in the innermost core of the atom have been proved to exist by firing high-speed alpha rays into aluminum atoms, scientists of the Physical Institute of the University of Halle report.

According to Dr. H. Pose and Professor G. Hoffman the capture of a helium bullet by the excessively small heart or nucleus of an aluminum atom has been used in this work to probe the last great secret of the structure of matter. For this collision of the alpha particle with the aluminum atom is the signal for the ejection from the aluminum nucleus of a still faster kind of rays, the proton rays.

Those protons have been successfully cross-questioned by Dr. Pose and made to tell the story of the aluminum nuclei they have so suddenly left. Actually they are the cores of hydrogen atoms in rapid motion.

Four to five million volts would be required to give the hydrogen cores their high speeds by artificial means.

The speeds of those protons and of the particular alpha ray projectiles which start them on their way give the new evidence of vibrations in the target atoms of the aluminum. At least Dr. Pose calls them vibrations.

Nothing material vibrates, however. Only a mathematical function with an incomprehensible formula and the Greek name Psi. Physicists have been wary of making concrete pictures of the inside of the atom recently since the arrival of the new quantum theory.

The Psi vibrations are found in tune with oscillations which accompany certain of the alpha rays on their journey, called the De Broglie waves, another of the conceptions of the new physics. A proton is ejected when these two kinds of oscillations get into step, just as an organist by playing the right note may wreck a building.

Distances traveled by the hydrogen particles before coming to rest in the air are used to measure their starting speeds. Dr. Pose found that three groups of hydrogens of differing speeds were sent out by the aluminum atoms.

The two faster groups which pass through 20 and 24 inches of air before stopping appear only when special speeds of alpha-helium rays are present in the projectile atoms. The speed of the alpha rays determines the frequency of the accompanying De Broglie waves.

Dr. R. W. Gurney, working at the Institute of Phys-

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ical and Chemical Research, Tokio, Japan, had previously suggested that resonance phenomena might be found in the nucleus similar to that observed in the outer layers of the atom. Dr. Pose believes that his own experiments show this. Slower projectiles with a voltage equivalent of 10 to 20 volts, for instance, cause the emission of colored light from the target atom when their speeds reach a very definite value.

Recent experiments of Drs. J. C. Chadwick, J. E. R. Constable and E. C. Pollard, at the University of Cambridge, England, however, show that "alpha particles which are not in resonance with the nucleus are nevertheless able to cause a detectable amount of disintegration."

The alpha rays used by the German investigators are helium atom kernels given out by polonium, radioactive substance similar to radium.

REPEAL OF THE TENNESSEE ANTI-EVOLUTION LAW

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JUDGE JOHN R. NEAL, chief defense counsel, Dayton anti-evolution trial, writes to *Science Service*:

"The bill to repeal the Tennessee anti-evolution law is a wholly spontaneous movement, originating in the legislature itself. It therefore gives great promise of success.

"Courage on the part of the State University and high-school authorities in supporting this repeal would secure its passage.

"While the Scopes case put an end to the movement for passage of bills similar to the Tennessee anti-evolution law in other states, its effect in Tennessee was not such as had been hoped for by the group of Tennesseans responsible for originating the famous case. The Supreme Court of Tennessee, while indulging in some dicta upholding the law, based these dicta only on technicalities not relating to the constitutionality of the act, and thus not only prevented an authoritative state decision, but prevented an appeal to the Supreme Court of the United States.

"Emotional misunderstandings aroused in Tennessee by the Scopes case have largely passed away, and the people of the state now see the anti-evolution legislation in its true light. They perceive that the sole question it presents is as to whether we are to have freedom of thought and freedom of teaching in Tennessee.

"With their minds unconfused as to the real issue, the Tennessee Legislature will undoubtedly bring Tennessee back into the ranks of civilized communities that desire for its youth the privilege of making their decisions for themselves."

With Judge John R. Neal, outstanding figure in Tennessee law and liberal politics, expressing his confidence that the Tennessee state legislature will repeal the law that five and a half years ago made the state a storm center of controversy and ridicule, the rest of the principal figures in the dramatic Dayton trial are remote from the new scene of action. They are not indifferent to the outcome of the effort to obtain a repeal of the

anti-evolution law, but they apparently feel that the legislators will do away with the law without the intervention of persons from outside the state.

The one man who might return to defend the bill against repeal, William Jennings Bryan, is dead. He was the first to pass of all those involved in the Dayton trial, and he died before the dust of the battle was fairly settled in the town where he had joined issue for a literal interpretation of the Bible against the upholders of science, whom he took to be its enemies.

Bryan's most dramatic opponent, Clarence Darrow, has retired from the practice of law and tries no more cases. He is heard from principally when he splinters a lance in debate over a philosophical or theological question. His associates, Arthur Garfield Hays and Dudley Field Malone, are still in practice in New York, and still make an exciting avocation of championing the cause of the economic and social under-dog. George Rappleyea, the engineer of Dayton whose suggestion over a glass of soda in a drugstore started the whole affair, is now in business in New Orleans.

John Scopes, the blond-haired, quiet young teacher who consented to be indicted and tried to make a test case of the statute and to his amazement found himself the center of a world-wide disturbance, continues his quiet way along the path of science. The trial crystallized a half-formed resolve he had to become a geologist. The autumn after it was over he entered the graduate school of the University of Chicago, and carried on his studies there for two years. Then he accepted a position as field geologist for an oil company, and spent three years in Venezuela. Not long ago he came back to America and now he is back at the University of Chicago, finishing his work toward the Ph.D. degree.

FORESTS OF PORTO RICO

PORTO RICO needs, among other things which will relieve her present economic distress, an entirely new set of forests. The island is a classical "horrible example" among foresters of the evil effects of a too eager stripping to make room for plantations, followed by a close gleaning for firewood and small lumber by an impoverished population.

In the early days, Porto Rico was like all the other larger West Indian islands in having a splendid mantle of forests. The accounts of several of the first explorers who followed in the wake of Columbus tell of dense stands of timber on the rainier slope of the island. Even in the eighteenth century there were still extensive forests there.

But the desire of planters and lumbermen to exploit the wealth of Porto Rico as rapidly as possible has resulted in the clearing away of practically every scrap of the original timber and the prevention of any worthwhile new growth. The island is now almost as denuded as the more densely settled parts of China, and is suffering like that old land from soil erosion and impoverishment.

If Porto Rico's forests are to come back, it will be necessary to spend effort and money on them. There is

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a great deal of low-grade bush land on the island, especially on the drier slopes away from the rain-bearing winds; but this will never develop into forests of economic value if left to itself. Much of it can never be turned into good forest land in any case, for the soil is too poor; but even where the soil is good and rainfall sufficient, human assistance is necessary to pull the forest succession out of the vicious cycle of brush into which it has been plunged by greedy and improvident over-cutting.

PARALYSIS CAUSED BY THE FEVER TICK

THE deadly western fever tick which causes tularemia, Rocky Mountain spotted fever and Colorado tick fever, has been found to cause a strange type of paralysis in humans, dogs, sheep, foxes and to some extent in cattle. Investigations of this curious malady are now being made by the U. S. Public Health Service.

The disease, Dr. R. R. Spencer, of the service, states, is apparently due to the fact that when one of these venomous ticks feeds upon a person it simultaneously injects a paralyzing poison. This form of paralysis is unusual in that the effects cease almost immediately after the tick is removed from the body upon which it is feeding. The paralysis generally starts in the lower limbs and keeps climbing upward until the heart or the respiratory system becomes paralyzed.

The disease, as far as is known, is caused only by the female tick, because the male tick is not a constant feeder. The female tick clings to its host and gorges itself with the blood of its victim. At the time it feeds it injects into its victim this deadly venom. After a day or so the legs of the victim become numb and the paralysis continues until the heart or respiratory system becomes affected, and death results. The paralysis may be stopped at any moment by merely brushing the tick off the body.

The disease is not known east of the Mississippi River and even in the West human cases are rare. However, this venomous and versatile tick exacts a heavy economic toll each year by its destruction of sheep and other animals.

Because of the fact that the symptoms cease as soon as the tick is removed, various theories have arisen regarding the manner in which the tick poisons its host, according to Dr. Spencer. Some scientists are of the opinion that the venom is stored in the salivary glands of the insect and is slowly injected while it feeds. Others believe that it may be a virus with which the tick is infected, which at the time of feeding it imparts to its host. The problem is complicated because the tick may have to remain on a person for a few days before the person becomes paralyzed.

This strange paralysis, as well as all the other tick diseases, is to be investigated in the new laboratory which the U. S. Public Health Service is to erect in the West.

ITEMS

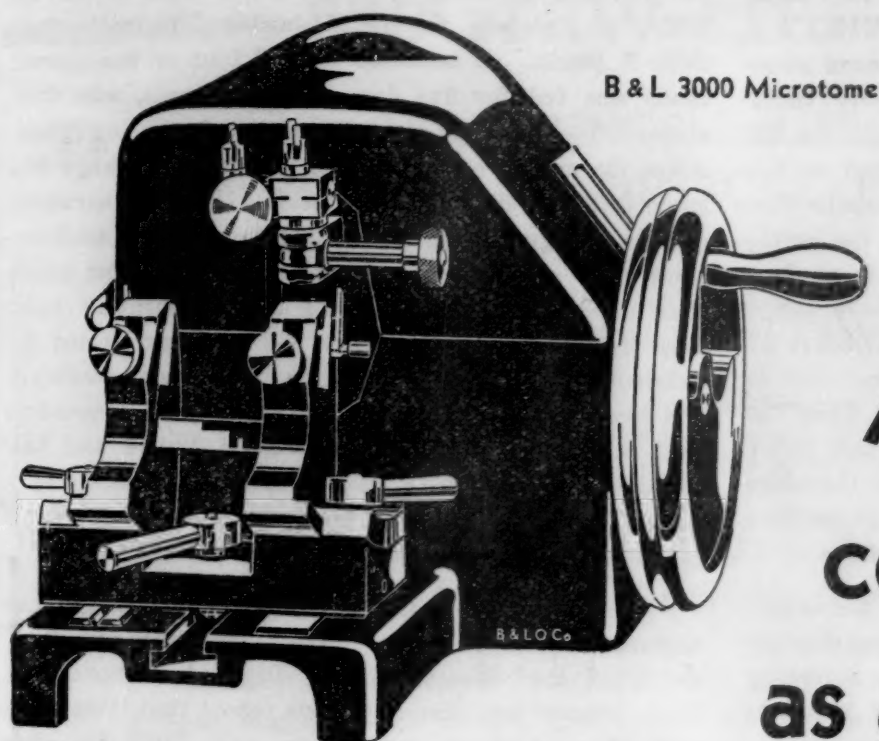
ICE from the North, and what brings it down into the navigated waters of the North Atlantic, will be the

subject of a scientific research program lasting throughout the coming summer, under the auspices of the U. S. Coast Guard. Dr. Olav Mosby, of Norway, has been sent out on the Coast Guard vessel *General Greene*, to work among the floes as they drift down the currents off the northeast coast of Newfoundland. The expedition will be based at St. Johns, Newfoundland. The *General Greene* will stay at sea for periods of ten days to two weeks, and will then put back to base for fuel and supplies. Besides the *General Greene*, which will take care of the strictly research side of the ice problem, the Coast Guard cutters *Ponchartrain* and *Mohave* will carry on the usual work of patrolling the steamer lanes in the iceberg regions, breaking up the bergs where practicable and keeping steamers warned of their presence by radio.

CARVED lines, sketchily outlining a pony's head on a scrap of slate, are the first specimen of cave-man art of the period known as Aurignacian ever discovered in Germany. The find was made in a cavern known as Balver Cave, in Westphalia, and is reported in the scientific journal *Forschungen und Fortschritte* by Dr. Julius Andree, of the University of Münster. Aurignacian man represented a stage of the Crô-Magnon development, which reached its highest point in France and northern Spain. It is hoped that other discoveries may be made in western Germany that will throw further light on the human occupation of Europe during the glacial epoch. The caves of Westphalia have lately yielded a wealth of stone and bone implements and weapons of culture-types ranging from the early Mousterian, which was the development of Neanderthal man, to late Magdalenian, very near to the end of the Crô-Magnard domination. Associated with these artifacts are the bones and teeth of animals used for food by the Stone Age peoples. They include cave bear, Arctic fox, wolf, moose and deer.

REPORTS from nine seismological stations to *Science Service* indicate that the ocean bottom off the coast of Chili, in the neighborhood of Santiago, was shaken by an earthquake early on the morning of March 18. The exact location of the epicenter was in longitude 72 degrees west, latitude 34 degrees south. Determinations made by the U. S. Coast and Geodetic Survey showed that the shock occurred at 3:02:03 A. M., eastern standard time, and that the tremors continued for three hours.

AMERICAN complaints of unwelcome animal gifts from Europe, such as the English sparrow and the starling, are returned with interest in the central countries, where the introduced American muskrat has become a pest of the first order. Valuable in his native land as a source of fur, the muskrat is a nuisance in Bohemia and parts of Germany, because of his inordinate multiplication and his activities in burrowing into river and canal banks. A war of extermination, official and unofficial, is waged against him. In Bavaria active efforts have retarded the advance of the muskrat. In one year 17,163 were reported as killed there. In Thuringia 3,493 were taken, and notably in the river systems of the Saale and Main a decrease has been noted.



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SCIENCE NEWS

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PAPERS AT THE INDIANAPOLIS MEETING OF THE AMERICAN CHEMICAL SOCIETY

ATOMS whose weight-bearing cores contain even numbers of both electrons and protons are twenty times more frequent than all others, Professor William D. Harkins, of the University of Chicago, reported to the American Chemical Society, meeting at Indianapolis this week. Of all the chemical elements found on the earth, said Professor Harkins, 95 per cent. belong to a class in which each building stone of the atomic core has a mate. The electrons of a pair in the central heart of the atom are not absolutely identical, however. One is spinning in the opposite sense to the other. Thus the nucleus as a whole is free from spin. These facts throw important light on the stability of atoms and therefore on the reason why some chemical elements, like radium, are continuously disintegrating into simpler atoms.

NOR enough atom-forming collisions occur in the depths of space to account for the intensity of penetrating cosmic radiation observed here on the earth, according to Dr. L. S. Kassel, of the U. S. Bureau of Mines at Pittsburgh. The theory of Dr. R. A. Millikan and Dr. G. H. Cameron, of the California Institute of Technology, that atom-building is the cause of the ultra-X-radiation that streams down into the earth's atmosphere from above, would require that in the formation of an iron atom, for instance, 28 electrons and 56 protons or hydrogen atom cores would need to meet at the right time. Dr. Kassel asserted that collisions occur ten million billion times too seldom for this. His calculation, however, is based only on the building of iron atoms, one of the many kinds of atoms which may, during their formation, give rise to penetrating rays.

COAGULATION or clotting of the liquid protein substances of brain and sensory nerves is the cause of the action of common anesthetic drugs. A challenge to the chemist is contained in this statement by Professor W. D. Bancroft, of Cornell University, to the American Chemical Society. Practically nothing is known about the nature or the properties of these animal proteins. Different proteins occur in different parts of the nervous system for suitable drugs can cause jellying of one region while leaving others untouched. Veronal causes reversible coagulation of the brain proteins without affecting the sensory nerves. Histamine coagulates the proteins of the sensory nerves. Curare causes partial clotting of the motor nerves, while potassium salts affect the proteins of muscle. Professor Bancroft's report was presented jointly by himself and Drs. J. H. Richter and J. E. Rutzler, also of Cornell University.

EXPERIMENTS designed to test whether canned foods can be used as the sole source of vitamins A, B and C, have shown that laboratory rats and guinea-pigs fare excellently on a diet consisting solely of canned goods. The experiments were made by Dr. E. F. Kohman, of

the National Canners Association; Professor W. H. Eddy, of Teachers College, Columbia University, and Celia Z. Gurin. A balanced diet of four or five canned foods was fed for five days to the animals, who were allowed to use their own discretion in eating them. After the end of each period of five days a change was made to a new dietary combination. Three generations of rats and guinea-pigs have thus dined on 74 combinations of 49 canned articles, and are now in better health than other animals fed on the usual laboratory stock fresh diets. Previous trials of this kind have tested the deficiency of a particular vitamin in a special foodstuff, and have not sought deficiencies which made themselves felt in later generations. Extremely varied and balanced diets of the kind used in these experiments have failed to give evidence for the belief that canned foods can not supply all dietary wants.

PHOTOGRAPHS of individual explosions in a gasoline engine were shown by Dr. Lloyd L. Withrow and T. A. Boyd, of the General Motors Research Laboratories. Much interest was caused by their report that "the products of combustion continue to emit light for some time" after the main burning process is over. Before this happens a narrow sheet of flame travels steadily through the charge and most of the burning takes place in this zone. The brightness of the afterglow increases with increasing pressure of the gases during the explosion. The method has been used to identify and study "knock" in auto engines.

IMPROVEMENT of a chemical test which will make detection of drunkenness by breath analysis more accurate was reported by Dr. Rolla N. Harger, of the Indiana University School of Medicine. Previous attempts to estimate the concentration of alcohol in the body by analyzing the breath have given quite erratic results. This is probably because the breath analyzed was not always air from the alveoli or air-cells in which exchange of oxygen and carbon dioxide between the blood and the lungs takes place. By the new method, the alcohol and carbon dioxide contents of the breath are determined simultaneously. Since the carbon dioxide content of alveolar air is constant, this gives a means of estimating the alveolar alcohol in any sample of breath. This method was used on a number of intoxicated subjects and the alcohol figures so obtained agreed well with the concentration of the alcohol in the blood determined directly.

PERIODS of rest or temporary abandonment of effort are quite essential to the successful research worker, according to Washington Platt, of the Borden Company, Syracuse, New York, and R. A. Baker, of the College of the City of New York. Several hundred research workers and directors of research had answered questions as to conditions which are favorable or unfavorable to efficient research. The majority agreed that "problems

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may be solved when the mind is on the fringe of consciousness." The mind must be provided with facts, but periods of temporary abandonment of creative effort are also quite necessary.

PAPERS AT THE BALTIMORE MEETING OF THE AMERICAN COLLEGE OF PHYSICIANS

A NEW test for heart efficiency was reported by Dr. Allen Eustis, of New Orleans, to the American College of Physicians in session at Baltimore, on March 24. The test is a valuable aid in the diagnosis and study of the type of heart disease known as myocardial insufficiency. The test may also be used with caution in cases of marked enlargement of the heart, angina pectoris and certain cases of high blood-pressure. By means of this test the physician will have a new gauge of how well the diseased heart can function. The test depends on the rise in the systolic blood-pressure following an increase in pressure within the chest caused by forcible expiration of the full breath under a definite amount of pressure. Dr. Eustis reported that clinical evidence corroborated the results of the test.

How chemicals known as nitrates act to relieve the agonizing pain of the angina pectoris was discussed by Dr. Alex M. Burgess, of Providence, Rhode Island. From a large series of studies of normal and diseased hearts Dr. Burgess concluded that the action of the nitrates in increasing circulation in the coronary arteries is what relieves the excruciating pain. The cause of the pain in ambulatory angina, the type in which the patient is up and about, is probably an insufficient blood supply due to disease of coronary arteries. Pain of the heart occurs when the degeneration of old age develops usually between the ages of 50 and 60 years, Dr. Alexander Lambert, of New York City, said. It comes when the degenerated heart muscles are inadequate to respond to the circulatory demand for increased heart output per beat. Use of oxygen in heart disease by a specially devised oxygen chamber or tent which keeps the temperature and the humidity at a comfortable level was described by the designer of the apparatus, Dr. Alvin L. Barach, of New York City.

EVIDENCE that there may be epidemics of hyperthyroidism, commonly known as goiter, was presented by Dr. William Carpenter MacCarty, of the Mayo Clinic. Dr. MacCarty's report was based on a study of over thirty thousand goiters, made during the past twenty years by his staff at the Mayo Clinic. Beginning about 1921, an increase of enlarged thyroid glands was noted. It is this increase which suggests the possibility of epidemics of hyperthyroidism. A classification of goiters which would enable practicing physicians to determine the form of the enlarged gland by examination of the neck was given by Dr. MacCarty. Two thirds of all the goiters examined during the twenty-year study fell in one class.

THYROID extract need not be given in treating most cases of obesity or overweight, Dr. Frank A. Evans, of

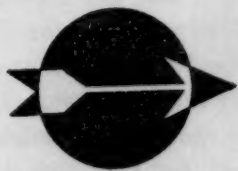
Pittsburgh, said at a symposium on the glands of internal secretion. Instead, Dr. Evans recommended a diet of between 400 and 600 calories on which the too-fat patients lose weight rapidly. They may be kept on these diets for months, if necessary, with nothing but improvement in their bodily condition. These patients feel better and have increased resistance to fatigue and they are contented with the diet. Thyroid extract should not be given because, among other reasons, it may disturb this feeling of contentment and well-being, and thus discourage the patient with the dietary régime on which he was improving.

AN extract of pituitary gland is often a powerful remedy for relieving the distressing thirst of diabetes insipidus, Dr. Thomas B. Fletcher, of Baltimore, said. This extract may be given by hypodermic or as a nasal spray. Diabetes insipidus is not to be confused with diabetes mellitus, the disease in which the body is unable to store and burn up sugars. In diabetes insipidus there is no excess of sugar in the urine, but great thirst, a voracious appetite, weakness and emaciation are symptoms of the disease. Injury to a newly-discovered meshwork of nerve fibers lying partly in the pituitary gland and partly in the neighboring part of the brain is probably the cause of diabetes insipidus, according to present theories, Dr. Fletcher explained.

THE vital hormone of the cortex of the adrenal glands, which has saved the lives of patients suffering from hitherto fatal Addison's disease, was described by Dr. Frank A. Hartman, of Buffalo, one of the investigators who prepared the extract containing the hormone.

LIQUOR was absolved from blame as being the chief cause of cirrhosis of the liver by Dr. A. M. Snell, of the Mayo Clinic, Rochester, Minnesota. Dr. Snell said that, contrary to generally accepted opinion, alcoholism caused cirrhosis in only half the cases of the disease. Furthermore, cirrhosis appears in only five per cent. or one twentieth of all alcoholic individuals. The outlook for the patient suffering from this highly fatal disease is better now than it was ten years ago, but it is still serious, particularly for advanced cases. Physicians are trying now to recognize the disease in the earlier stages when it may still be cured. Some of the early symptoms may be indigestion, weakness, vague abdominal pains and occasionally painless jaundice. Dr. Snell reported good results are obtained in some cases by newly devised operations for controlling bleeding from enlarged veins in the gullet that are invariably present in cirrhosis.

CARBOHYDRATES, the sugars and starches of the diet, are of outstanding value in the diet of animals suffering from extensive liver disease, Dr. J. L. Bollman, also of the Mayo Clinic, reported. He found that a diet rich in sugar and starch will protect the liver from damage by poisons and will aid in its recovery after such injury. The liver plays an active part in the coagulation of the blood. This is shown by the fact that hemor-



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rhage does not occur when the liver condition improves, although the veins may remain distended.

ITEMS

ICEBERGS will invade the North Atlantic to the number of about 310 during the coming season, is the forecast of Lieutenant Commander Edward H. Smith, of the U. S. Coast Guard. Commander Smith has for several years made a special study of ice conditions, and has worked out a method of forecasting which he believes will be of great value to the International Ice Patrol in its work of protecting transatlantic traffic during the iceberg season. The number of bergs anticipated for 1931 is not exceptional. The maximum recorded during the modern period of intensive study and reporting of icebergs was for the year 1929, when 1,300 came down out of the North. The lowest figure was for 1924, when only eleven were reported.

THE newly discovered faint speck of light in the heavens has been sighted through the 26-inch telescope of the U. S. Naval Observatory and pronounced an asteroid or minor planet. Mr. H. E. Burton, astronomer, determined the position of the rapidly moving object and Messrs. William M. Brown and John E. Willis, of the U. S. Naval Observatory staff, completed a preliminary computation of the object's orbit or path in the heavens. Two German astronomers, Schwassmann and Wachmann, of Bergedorf Observatory, near Hamburg, who have won fame for many such discoveries, made the announcement of the discovery of the asteroid.

THE "electric sign of the sky," a star flashing out brightly every 100 minutes, has been discovered by H. van Gent, of the Leyden Observatory. The discovery was made while Mr. van Gent was performing research at the Union Observatory, in Johannesburg, South Africa. Many variable stars, which regularly change in brightness, are known and studied by astronomers, but this one, which is in the southern constellation of Puppis, part of Argo, the ship, changes more rapidly than any other known variable. Usually the period is a matter of days.

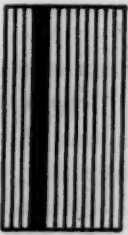
STUDY of flax by botanical and chemical methods shows that it contains a valuable wax. Linen and linseed are the commercial products now produced from flax. To the Institution of Chemical Engineers, in London, Dr. W. H. Gibson has reported that flax wax is nearest in character to beeswax, but has a distinctly higher melting point. It is somewhat harder and more brittle. For these reasons it gives an extremely high polish, and the film is stated to be more durable than that given by carnauba, the tropical palm wax most used in high-grade polishes. Dr. Gibson estimated that in the Belfast area of northern Ireland possibly 1,000 tons of flax dust could be obtained per annum, from which about 60 tons of flax wax could be secured.

FISHES that have taken to living mostly on land because they can't breathe in the water that is available


to them, were among the curiosities described by Professor A. S. Pearse, of Duke University, before a joint meeting of the American Society of Zoologists and the Ecological Society of America. There are a number of fish species that live in the shallow waters of the Oriental tropics. They spend a great deal of their time as air-breathers, scrambling around on land and even climbing up on the low vegetation of the shores. Sometimes they get more or less mythical reputations as tree-climbers. It has usually been assumed that these fishes have developed their ability to breathe air because their pools periodically dry up. But Professor Pearse suggested that they may be forced to leave the water because it is so stagnant and warm, and so teeming with other, smaller animal life, that it simply does not have enough oxygen left in it to keep the fish alive by means of the gill respiration which all orthodox fishes are supposed to depend on.

CHESTNUT forests now dead or dying from the blight can be salvaged twenty years hence for the tanning and paper industries, a recent report by the paper section of the Bureau of Standards of the U. S. Department of Commerce states. Despite efforts to introduce blight-resisting trees from Asia into this country, this spread of the disease together with the commercial exploitation of the chestnut by the tanning and paper industries indicates the ultimate exhaustion of American chestnut forests. The day when a shortage will be felt has been postponed by many years, however, through the discovery that dead trees can be used as a source of paper and tannin. Investigations conducted by the Bureau of Plant Industry, U. S. Department of Agriculture, have revealed that dead trees suffer no appreciable loss of tannin even over long periods of time. It has also been demonstrated that dead trees can be used in paper manufacture and a paper-board mill has been recently built in the worst blight-infected territory with expectations of using the trees for twenty years.

THERE is less oxygen in the water of the Pacific Ocean than there is in Atlantic Ocean water. There is more oxygen in the water of great depths of both oceans than there is in water from moderate depths. These are among the discoveries made by Dr. Erik G. Moberg, of the Scripps Institution of Oceanography, after a chemical study of thousands of samples of ocean water. Since all plant and animal life in the ocean is dependent on oxygen no less than is life on land, such studies as Dr. Moberg's are of fundamental practical as well as theoretical importance. Dr. Moberg found the greatest oxygen content in Pacific Ocean water at the surface. Here the water was nearly saturated with oxygen. The content fell off in samples taken from increasing depths, until at about 2,000 feet there was less than one part of oxygen per thousand of water. From this depth onwards the oxygen content increased again, reaching its highest point at the bottom. The highest deep-water oxygen ratio found was 3.45 parts per thousand of water.



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SCIENCE NEWS

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THE SEISMIC RECORD FOR 1931

THIRTY-FIVE earthquakes in three months, five of them major disasters to life and property in widely scattered parts of the world, is the appalling seismic record of 1931 to the end of March. Eleven quakes recorded in January, eleven in February and thirteen in March, culminating in the catastrophe that on the thirty-first overtook the city of Managua in Nicaragua, tell the story of an abnormally trembling earth.

These thirty-five earthquakes count only the ones important enough to figure in the day's news or to trace their autographs on the ever-vigilant instruments in seismological observatories. The lesser quakes that happen every day, the mere local shocks, were not counted. The data have been gathered for the use of scientists of the U. S. Coast and Geodetic Survey by *Science Service*, from the stations of the Jesuit Seismological Association, from official observatories of the United States and Canadian governments, and from numerous universities.

The first of the great earthquake disasters of the year came on January 14, when the wires bore the tale of ruin in towns of northwestern Argentina, followed by destructive floods and by volcanic eruptions.

On the very next day the city of Oaxaca, in southern Mexico, was ruined by an earthquake, and Mexico City itself, remote though it was from the center of the disturbance, was severely shaken and somewhat damaged; after-shocks on the sixteenth and seventeenth prolonged the terror in stricken Oaxaca.

On the second day of February came the New Zealand shock, destroying several fine towns, wrecking harbors and killing hundreds. This disturbance was of the peculiarly distressing kind in which there is a considerable tilting of the earth's crust, humping it up in some places and depressing it in others, reducing old established ground levels to anarchy. There were several after-shocks in the New Zealand area, notably one on the thirteenth.

March started out with a record of comparatively little damage, the earthquake of the fifth, along the coast of Chile, wrecking a number of houses but not figuring as a major disaster. The eighteenth of the month distinguished itself by staging two earthquakes, neither of which, however, figured in the world's tale of troubles.

Then, on the last day of the month, came the quake that overwhelmed the hapless Central American city in ruin, with sequelae that are only now struggling out by wire and radio.

THE NICARAGUA EARTHQUAKE AND THE PROPOSED CANAL

WHETHER the earthquake in Nicaragua will have the effect of wrecking the second American interoceanic canal before it is built is a question that will come up when Congress is again in session.

When the need for an interoceanic canal in the Western Hemisphere, long pressed by commerce, was brought

home acutely to the American consciousness by the long voyage of the battleship *Oregon* during the Spanish-American War, Nicaragua was thought of more favorably than Panama. It was closer, the altitude was less, and the ground was not cluttered up by the French failure and scandal that made such an unhealthy atmosphere at the Isthmus.

But when it finally came to practical discussions before the Congress, the advocates of the Panama route rallied their forces. They pointed out that there were active volcanoes along the line of the proposed Nicaragua Canal, and that it was also in an earthquake country. Panama has no volcanoes and the earth there is quiet. There is a story of how Nicaraguan postage stamps showing a smoking volcano were sent to all members of Congress by the Panama backers, and helped to influence the final decision against the construction of the canal in such a "dangerous" country.

But since the building of the Panama Canal, the Nicaraguan earthquakes have kept pretty well away from the canal route and the Nicaraguan volcanoes have been behaving themselves. A new generation has inherited charge of public affairs, and the project of a second canal has received considerable impetus from the crowding of the Panama Canal that seems to be in fairly near prospect.

And now comes a wrecking earthquake, centering under one corner of Lake Nicaragua, which the canal would have to traverse, and ruining the city of Managua, which would naturally have a very considerable economic tie-up with the personnel of any major transportation work in the region. Such an earthquake could do immense damage to canal locks, power-houses and other mechanical appurtenances; or, if the canal were an ocean-level one, it might slide the side of a mountain into the narrow cut.

On the other hand, a good solid earthquake shock usually takes the mischief out of a given region, so that no more heavy shocks need be expected for a good many years to come. Earthquakes result from the building up of a state of tension in deep rock strata; after the slip has occurred the tension is relieved and only minor shocks follow. For this reason, the region around the northwestern end of Lake Nicaragua is safer from earthquakes to-day than it has been at any time during a considerable period of years.

THE USE OF PROTECTIVE SERA

A NEW chemical process that is expected to eliminate all danger from protective or curative serum administrations was reported by Professor J. Bronfenbrenner, of Washington University, St. Louis, at the Cleveland meeting of the American Association of Immunologists.

The use of these sera has become increasingly useful in treating diseases and for giving protection from diseases. Toxin-antitoxin for diphtheria and antitetany injections are familiar examples. Occasionally, however,

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such serum injections are followed by grave complications and even death. This has made some physicians hesitate to use the sera.

Only one in 20,000 of those receiving serum for the first time develop alarming symptoms and only one in 50,000 die as a direct result of the treatment. The reason for the hazard is that some persons have a specific sensitivity to foreign protein. Such are the victims of asthma and hay fever. The same protein does not always affect all sensitive individuals, some being sensitive to the protein of horse serum and not sensitive to serum from other animals or to protein from other sources.

The human race may be divided into four categories with respect to their response to injections of these sera, Professor Bronfenbrenner pointed out. Some, about one tenth, have no ill effects after the injections. A small group, about one in 20,000, respond to injection of horse serum by an immediate violent reaction leading to collapse and sometimes to death.

The bulk of people when given serum injections have so-called serum sickness to more or less severe degree, varying from soreness at the point of injection to generalized fever and indisposition. These are considered normal in their reactions, however. The fourth group is composed of persons who may have reacted normally originally, but who became sensitive to serum as a result of previous injection. These may develop serum sickness very quickly and some of them may suffer severe complications and even die.

The process developed by Professor Bronfenbrenner and colleagues, Messrs. D. M. Hetler and I. O. Eagle, of Washington University, changes the chemical nature of the serum protein, so that it loses the quality of causing a specific reaction to it, but at the same time the immunizing or curative properties of the serum are left almost as effective as they were in the original serum. Studies with animals showed that the new preparation of sera is not toxic. Further improvement of the chemical procedures is being sought in order to leave the curative and immunizing properties of the sera unaffected in potency.

TREATMENT FOR LEUKEMIA

THE conquest of a fatal disease, leukemia, may soon be made as the result of experiments reported to the American Association of Pathologists and Bacteriologists, by Dr. W. C. Hueper, of the cancer research laboratory of the University of Pennsylvania.

Certain kinds of cancer are closely related to leukemia, which is a riotous growth of the white blood cells and a lessening of the red cells of the blood. The successful research by Dr. Hueper and his associate, Miss Mary Russell, may therefore be an important step toward the relief of cancer itself.

The first step in the development of the new treatment for leukemia was the growing of leukocytes, or white blood cells, in tissue culture outside the human body. Dr. Hueper was successful in causing the diseased over-ambitious white blood cells from a leukemic patient to thrive on artificial food given them in a glass tube.

Leukemic white cells were injected in a perfectly healthy rabbit causing a fight to occur between the abnormal white blood cells injected and the protective chemical forces in the rabbit's blood that resist any unmannerly and unruly multiplication of the white cells. As a result there was built up in the rabbit's blood an unusual amount of substance that discourages the increase of white blood cells. Serum from the rabbit's blood containing this inhibitor was used for the treatment of leukemia.

So far only one human case of the disease has been treated and this was a case of long standing. The improvement of this patient was remarkable although a complete cure will probably not be possible. Using their own blood, Dr. Hueper and Dr. Ellice McDonald, director of the laboratory, made tissues of the cultures and showed that the anti-leukemic serum stopped the growth of the white blood cells. This causes them to be confident that the serum when applied clinically will check the disease.

Following closely upon the recent successful treatment of pernicious anemia with liver extract, Dr. Hueper's anti-leukemic serum promises to make an equally important conquest of disordered white blood cell conditions. Anemia is an abnormal lessening of the red blood cells, while leukemia is an abnormal increase of the white cells.

While leukemia is not a widely prevalent disease, it may be found in nearly every hospital of any size. Some forms seem to be hereditary. It is nearly always fatal. Often leukemias of long standing turn into the form of cancer known as leukosarcoma, a malignancy of the glands of the body.

THE SURVIVAL OF DRY BACTERIA

NOT all bacteria die when deprived of water and placed in arid surroundings, experiments of Dr. C. N. Stark and B. L. Herrington, of Cornell University, have shown. The investigation was undertaken in the hope of throwing light on the perplexing question of whether life without water is possible. According to one scientific view, perfectly dry bacteria would live forever. The opposite view is that in the complete absence of water life is impossible.

The facts can probably never be definitely determined, according to the report made to the Society of American Bacteriologists.

Those who believe that really dry bacteria will live forever can always maintain that death occurred as a result of the method of drying the bacteria, rather than from the dryness itself. Similarly it can be held by others that failure of the bacteria to die was due to incomplete drying. The problem is further complicated by inability at present to distinguish between free water, bound water and water of constitution.

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vive under the dry conditions. The material on which the organisms grow is an important factor. Exposure of extremely dry bacteria to free oxygen gas caused a pronounced killing of the bacteria.

A RHEUMATISM VACCINE

A VACCINE for rheumatism that holds promise of bringing to the medical profession a successful treatment for that common disease is now in an experimental stage of development, Professor Benjamin J. Clawson, of the University of Minnesota Medical School, disclosed in a paper read before the American Association of Pathologists and Bacteriologists.

Not for at least a year will it be possible for this new vaccine to be used by physicians generally. At present Professor Clawson is presenting his tentative results to his scientific colleagues, and his paper was entitled: "Experiments Relative to a Possible Basis for Vaccine Therapy in Rheumatic Fever."

Rheumatic fever, arthritis, or rheumatism, as the disorder is variously known, is a very common disease. It is wide-spread throughout the world. Professor Clawson in making his vaccine takes the causative organism, *Streptococcus viridans*, which he has repeatedly isolated from the blood of patients having acute and chronic arthritis. This germ is heat-killed to make a vaccine in a conventional manner. This vaccine is not injected under the skin as is a common practice, since this method would tend to make the patient more hypersensitive. Instead it is injected directly into the blood stream.

In testing his vaccine upon actual patients, Professor Clawson is treating approximately a hundred sufferers from the disease. The vaccine will not be given general use until the results of these tests are known.

ORIGIN OF COSMIC RAYS

COSMIC rays, the intensely "hard," all-pervading radiation that comes from somewhere in outer space, may come in some small degree from the sun.

This is indicated by recent researches of Professor Viktor Hess, of the University of Graz, one of the pioneers in cosmic ray research. With instruments set on heights in the Alps, he and other physicists have detected a very slight increase in the intensity of the radiation when the sun is at mid-heaven. This averages only about one half of one per cent. of the total radiation, but, according to Professor Hess, it is a constant, and hence probably a significant, variation.

If the sun really is the source of even a small fraction of the cosmic radiation, it lends support to the view held by a number of European investigators that these rays come from the stars, for the sun itself is a star, and not a very large one at that. Experiments conducted by two of Professor Hess's colleagues, Dr. O. Mathias and Dr. Steinmaurer, have indicated that there is about a two per cent. daily variation from average intensity. They are still engaged in checking up on this result.

Professor Hess adds, however, that even if the stars are definitely shown to be sources of cosmic rays, this does not wholly shut out the possibility of a part of the rays coming also from interstellar space.

ITEMS

DANGER lurks in typhoid vaccine if it is improperly prepared, stored too long or not accurately tested, said Professor Stuart Mudd, of the University of Pennsylvania, speaking before the American Association of Immunologists at their recent meeting. He discussed a small epidemic which occurred in an institution where inferior antityphoid vaccine was used. The value of the typhoid vaccine for giving immunity to typhoid fever depends, among other things, on the quality of the vaccine. Vaccine should be used within a few months after preparation.

POSSIBILITY that the later and more disastrous effects of the eye disease trachoma may be the result of two germs working together was demonstrated by Dr. Peter Olitsky, of the Rockefeller Institute for Medical Research, at the meeting of the American Association of Pathologists and Bacteriologists. Before his death Dr. Hideyo Noguchi, of the Rockefeller Institute, had isolated a germ from human cases of trachoma which he believed caused the disease. This germ could produce a disease resembling the early stages of trachoma in monkeys and apes. Continuing Noguchi's work, Dr. Olitsky with his colleagues, R. E. Knutti and J. R. Tyler, have produced a disease closely resembling the later stages of trachoma, in which blindness occurs, by the action of the granulosis microbe discovered by Noguchi in conjunction with other bacteria found in the eyelids.

INSTEAD of becoming extinct, moose are rapidly increasing in Sweden, thanks to restrictive game laws. During last year's brief open season of three days 5,082 animals were killed, according to official figures. This means an increase of more than 800 over 1929 and 1,360 over 1928. Since each animal is worth about fifty dollars, the total value of the moose killed in 1930 is about 1,036,400 kroner (\$277,755). In spite of this heavy killing, the moose herds in central and northern Sweden increase annually, and cause many farmers actual losses because of the damage they do to crops and young trees. In most parts of the country the moose cows and calves enjoy constant immunity while the open season for bulls lasts but a few days, according to their prevalence in each district.

SEEDS of the Para rubber tree yield an oilcake and meal that is good feed for livestock, as shown by experiments at the Virginia Experimental Station. Earlier reports from the East Indies stated that the seeds are poisonous to farm animals, but this claim has not been borne out in these tests. The rubber-seed oil meal analyzes 33 per cent. protein and six per cent. fat, besides non-nutrient constituents. Cattle and sheep are said to relish it. The question of the suitability of the oil meal has come up as the result of experiments on the production of a commercial oil from the seeds of rubber trees on East Indian plantations, initiated by an American chemist, E. D. Gothwaite, of Belawan, Sumatra. He found that rubber-seed oil can be used to advantage as a drying oil, slightly inferior to linseed and tung oils in its qualities, and that after suitable treatment it might even be made available for use as human food.

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SCIENCE NEWS

Science Service, Washington, D. C.

MAGNESIUM STARVATION

A NEW kind of starvation due to lack of magnesium, and a hitherto unsuspected relation between the adrenal glands of secretion and magnesium as a constituent of the diet, was described for the first time by Dr. E. V. McCollum and Dr. Elsa Orent, of the Johns Hopkins School of Hygiene and Public Health. Their report was made at the Montreal meeting of the American Society of Biological Chemists. Convulsive death results from the magnesium lack.

Dr. McCollum, a pioneer in the study of vitamins, has thus demonstrated another essential to life itself. Magnesium is familiar as a metal, lighter in weight than aluminum. It also is a part of many chemicals. It is contained in the drugs, milk of magnesia and epsom salts. A very small amount of magnesium is a necessary part of the normal diet. How necessary it is and why has only just been discovered.

Drs. McCollum and Orent found that eleven days of a diet wholly lacking in this element causes convulsions and death in the majority of rats. On the third day of a magnesium-free diet white rats developed bright red ears and tails. In fact, wherever the skin showed through the hair, it was seen to be very red instead of the usual color. Apparently the outlying blood vessels were wide open so that all the blood flowed to the ends of the vessels just beneath the skin.

On about the tenth day of this diet, never later than the eleventh, the rats behaved strangely. Ordinarily they pay no attention to what is going on about them and are undisturbed by noise. But after ten days of the diet, the slightest noise, such as the rattling of a piece of paper or a shadow falling across the cage, agitated the rats so greatly that they whirled around two or three times and collapsed in a clonic spasm. Their breathing was disturbed, their eyes protruded and at the same time the blood rushed away from the vessels just under the skin so that the ears and tails were blanched. The blood rushed to the heart, the small blood vessels contracted, and since the heart could not pump the blood out again it became enormously enlarged. Eighty-five per cent. of the rats died in this spasm, the remaining 15 per cent. living on indefinitely, some for as long as 90 days, a long period in the life cycle of a rat.

When magnesium is omitted from the diet, calcium and phosphorus are drained out of the body, so that not enough is left to make an X-ray of the rat's skeleton. This is the only way known to decalcify the body.

The explanation for all this, Dr. McCollum thinks, is that there is much the same relation between the adrenal glands and magnesium as there is between the thyroid gland and iodine, or the parathyroid glands and calcium. In the convulsions of parathyroid tetany, the nervous system can be quieted by administration of calcium. The symptoms of magnesium deprivation seem to be exaggerations of the adrenal glands' response to fear or anger.

Here is evidence that two more endocrine gland systems are tied up with two inorganic structures. No relation between them has been known before, Dr. McCollum pointed out, referring to the magnesium study and to his previous study on the effect of manganese on the body. Absence of this substance effects the propagation and rearing of the young, even wiping out such a powerful emotion as maternal solicitude.

MILK PROTEIN

THE discovery of a new essential to life contained within the protein of milk was announced by Dr. W. C. Rose, of the University of Illinois, in a report to the Federation of American Societies for Experimental Biology meeting in Montreal.

At present its identity is hidden in the complexity of the brownish, somewhat crystalline powder that Dr. Rose's laboratory records describes as the "active fraction" of casein, the protein contained in milk. Extensive feeding experiments upon white rats led Dr. Rose and his coworkers, Dr. Ruth H. Ellis, W. Windus and Miss Florence Gatherwood, to the finding of the new life essential.

The protein portions of the food given these animals was replaced by highly purified amino acids, which are known to be the chemical building blocks out of which nature constructs the necessary proteins in food. Proteins make up one of the classes of foods in our diet, and they are contained most extensively in meats, milk products and other such foods.

All the twenty known amino acids were used in the diets of the rats. If these twenty chemical compounds were all that makes the proteins of natural food satisfactory for growth and maintenance, then Dr. Rose's rats should have grown well and waxed fat. But they did not. They were not getting something that they needed in their amino acid substitutions for protein.

Starting the search for the unknown food essential, Dr. Rose added small amounts of casein from milk, gliadin from wheat and gelatin from meat to the menu, in order to find where the new essential occurs in nature. The casein helped the rats to grow. By chemical processes this protein was split into pieces until finally a fraction was found that caused the animals to grow normally when just five per cent. of it was added to their purified amino acid meals. This fraction is obtained from the casein by butyl alcohol extraction under appropriate conditions.

Dr. Rose can not yet assign this hitherto unrecognized food factor to a proper place among the vital food essentials, such as vitamins and amino acids. More research will be necessary before this can be done. It may prove to be an amino acid, of which twenty are known to science. Four out of these twenty are known to be absolutely essential to life. These are cystine, tryptophane, lysine and histidine.

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LIQUID HELIUM

AN extremely cold piece of tin conducts electricity a hundred thousand times better than tin at ordinary temperatures, it was confirmed by physicists of the National Bureau of Standards when they liquefied helium gas for the first time in the United States.

Helium is the most difficult gas to turn into a liquid. A coil of tin through which electricity was passing was used as one method of proving that a temperature within three degrees Fahrenheit of the lowest temperature ever created by man had been achieved. The greatest cold, called absolute zero, is 459.4 degrees below zero on the Fahrenheit scale. The lowest temperature reached in the Bureau of Standards experiment was minus 456 degrees Fahrenheit, while helium liquefied at minus 450 degrees.

Dr. H. C. Dickinson, Dr. F. G. Brickwedde, W. Cook, R. B. Scott and J. M. Smoot, working in constant danger of their lives, and late at night, won a friendly race with the Johns Hopkins University and the University of California for the honor of being the first institution in America to liquefy helium.

Helium is the rare gas of the air, first discovered in the sun, which is obtained from natural gas in sufficient quantities to float in the air the giant airships of the American Navy.

To turn it from a gas into a liquid, liquid hydrogen is made by compressing this highly inflammable gas to 2,200 pounds per square inch, cooling it with liquid air, then allowing it to expand in order to further cool itself. Then helium is compressed to 200 pounds per square inch and the liquid hydrogen is used to cool the helium. When the helium, already intensely cold, is allowed to expand it gets so cold that it becomes liquid, the goal of the experiment.

Helium was first liquefied at Leiden, Holland, where the late Professor Kammerlingh Onnes carried out his work in low temperature research. The Berlin Imperial Institute and the University of Toronto have also made liquid helium.

ATOMIC NUCLEI

DRS. J. C. CHADWICK, J. E. R. Constable and E. C. Pollard, of the University of Cambridge, have bombarded a variety of atomic nuclei with fast moving alpha rays from polonium, a radioactive element. They found that energy is done up in packets or quantized in the nucleus as elsewhere in the atom.

"What is happening in the inner core of the atom?" is the question that is being asked now in many laboratories of physics. The nature of the electron layers that form the bulky outer coat of the atom is well known, but the very small nucleus which gives matter its weight is still a problem. Protons, electrons and alpha particles are the constituents of the nucleus. The protons are themselves nuclei of the smallest atoms, that is of hydrogen, while the alpha particles are helium nuclei. Protons have been ejected from certain atoms by Dr. Chadwick by bombarding them with the rapidly moving alpha particles from the polonium, an element very like radium.

Two things may happen. The destructive alpha particle may be swallowed up by the second nucleus or it may escape again. In both cases Dr. Chadwick found proton rays were produced. If the alpha particle penetrates the target nucleus, protons of only two or three definite speeds are produced. Thus only limited and fixed amounts of energy can come from the nucleus at these times and fresh evidence is found for the quantum theory which has been so powerful in probing the structure of the atom. Non-penetrating collisions, however, lead to protons whose speed depends on the speed of the guilty alpha particle. As might be expected more of such protons are found moving along the line of motion of the hitting alpha particle than in other directions. The proton speed groups have given proof of the existence of energy levels in the nucleus, at least so far as the protons are concerned. Nothing is yet known about the behavior of the electrons in the nucleus.

COOPERATION OF ENGINEERS IN ANTHROPOLOGICAL WORK

COOPERATION between scientists and engineers, road-builders and other professional men conducting large-scale digging operations, in a search for remains of early man in America, was arranged at a conference held recently in Chicago under the auspices of the National Research Council.

Because some of the most important of the old-world finds of ancient man were made in quarries, gravel pits and other utilitarian excavations, it was believed by the organizers of the program that a well worked out plan, enlisting the assistance of interested engineers and contractors, might be productive of equally important results on this continent.

Since the early history of man was tied up closely with the coming and going of the glaciers of the Great Ice Age, it is believed that the most promising places to look for evidences of early human existence will be deposits of gravel and other material left behind by the retreating ice. Professor Fay-Cooper Cole, of the University of Chicago, introduced the general subject of early man in America, and Dr. W. C. Alden, of the U. S. Geological Survey, discussed the spread and movements of the great ice sheets in the Middle West.

What the engineer or road-builder may do, to be of the greatest service to science, was suggested by Dr. M. M. Leighton, chief of the Illinois State Geological Survey. He said, in part: "Engineers and operators in charge of all kinds of excavation work such as road-building, sewer construction, dredging ditches, quarrying and clay, sand and gravel industries are in position to make valuable contributions to science with regard to the geological history of man in America, by preserving *in situ* suggestive evidences of human occupation, whether it be skeletal remains or the relics of his activities, until the scientific evidence of the geological position and age can be determined by a geologist and notifying the state geologist of that particular state regarding the potential discovery; such leads should be followed by prompt examination on the part of the state geologist or some capable geologist whom he may designate.

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"The whole procedure could be encouraged by the establishment of a geological minute-man service similar to the archeological minute-man supported by *Science Service*, whereby moderate sums covering the cost of the field examination may become instantly available. These forms of cooperation should prevent any further loss of critical scientific data bearing on the geological history of man in America."

Assurance of willingness to cooperate on the part of engineers and operators was given by Mr. C. M. Conner, of the American Roadbuilders' Association, Washington, D. C. He suggested a brief practical outline of the knowledge a cooperating engineer will need, under four heads: what is sought and how to identify it; where it is likely to be found; whom to notify of the find, and how to protect the find. Mr. Conner also told of an important archeological find made by a contractor operating on a National Highway job in Mexico, on which he was then serving as engineer.

Representing the Smithsonian Institution, which has done pioneer work in research on the possible presence of prehistoric man in America, Dr. M. W. Stirling told of the work of his colleagues, especially Dr. Aleš Hrdlička and Dr. J. W. Gidley, the latter of whom has made discoveries in Florida which strongly suggest the possibility of man's presence while such animals as the mastodons and ground-sloths were still in existence. To the argument that the comparative lack of human bones and especially of man-made implements indicates that no men were here in early times, Dr. Stirling opposed the suggestion that the earliest men may have been so primitive that they were not yet tool-users. And even if paleolithic man is not found in America, he added, it is still of great interest to know who the very earliest comers were and what was their stage of cultural development.

ITEMS

ASTRONOMERS at the Mount Wilson Observatory have recently observed a marked increase in the number of spots on the face of the sun. On April 10, a total of twenty-six spots were counted in three groups, while the day before the number was even higher, thirty-seven. They have been plentiful all week as compared with last week when the number ranged from only three to thirteen. An increase in the number of sun-spots is associated with impaired radio reception, it has recently been discovered by Dr. Harlan T. Stetson, of the Perkins Observatory, Ohio Wesleyan University. It is Dr. Stetson's prediction that the spots will gradually decrease and radio reception improve throughout the rest of the year.

THE new 69-inch telescope of the Perkins Observatory of the Ohio Wesleyan University, Delaware, Ohio, is expected to be in operation by June. The large mirror, to be the third largest in the world, is now being ground and polished at the factory of J. W. Fecker Company, Pittsburgh. Dr. Harlan T. Stetson has been advised that the extremely accurate "figuring" of the giant

piece of glass is progressing more rapidly than in the case of other large telescope mirrors because of the high quality of the boro-silicate glass cast by the U. S. Bureau of Standards. This mirror is the first large telescope disc to be made in America. As the telescope mounting has already been installed by the Warner and Swasey Company, Cleveland, the new 69-inch telescope will be the first large telescope to be made completely in America.

HEATING the soil in seed-beds by electricity, to hasten sprouting and early growth of plants in early spring, has been tried on an experimental scale in Sweden and Germany and is considered economically promising by Oskar Schwenninger, a Berlin engineer. The heating units are cables of suitably high resistance, insulated and buried about a foot under the surface of the ground. It has been found possible to maintain a good germinating temperature in the soil when the air temperature is near freezing.

DR. WILLIAM B. BREBNER, of Washington University, St. Louis, has reported to the American Association of Pathologists and Bacteriologists progress in the understanding of the nature of infantile paralysis or poliomyelitis. Working with monkeys, the animal that is most closely related to man in its reactions to medical treatments, Dr. Brebner was able to produce immunity against the virus of poliomyelitis by the injection of the virus of the disease directly into the spleen of the animals. This was a purely experimental procedure since an operation, impractical in the case of a human patient, is necessary in order to make the injection into the spleen. However, blood from the immunized monkeys showed resistance to the active virus of the disease and this was taken as an indication that the procedure may prove of some use in suggesting ways of protecting against this disease.

"TASTE BLINDNESS" is the only term that can be found to describe the reaction of those who can not taste para-ethoxy-phenyl-thio-urea, for those who can taste it find it intensely bitter. This curious difference in perception has been discovered by Dr. Arthur L. Fox, of the laboratories of E. I. duPont de Nemours and Company. He has tried this very complex organic compound on every one who would volunteer to taste it, and has found that approximately three fifths of his "victims" declare it intensely bitter, while the rest say that it "has no more taste than sand." Para-ethoxy-phenyl-thio-urea is a close chemical relative to another compound, known as "dulcin," which is several hundred times as sweet as sugar. To make dulcin, one atom of sulphur is dislodged from the molecule of para-ethoxy-phenyl-thio-urea and an atom of oxygen substituted for it. Dr. Fox has found that this curious "taste blindness" is displayed by the same persons to other compounds as well, all of them of the thiourea group. But so far as known, dulcin tastes sweet to everybody.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE MIGRATION OF ELECTRONS

SCIENCE now believes that the electrons in a piece of cold metal are more active and sociable than formerly, but current theories make it still as difficult for an electron to get a passport to the foreign air beyond the metal's boundaries.

Dr. Charles E. Mendenhall, of the University of Wisconsin, has presented to physicists an interesting picture of the changes in the behavior of the free or roaming electrons in metals, which has been brought about by the revolutionary discoveries of the new quantum theory. It is to the electrons of this kind that the most characteristic properties of metals are due, notably their reflecting surface and the ease with which they conduct electricity and heat.

Formerly there was no check on the activities of the individual electrons of this family. They were all vagrants. The new statistical theories of Heisenberg, Shroedinger and Dirac change all this. Each electron is now registered in the census of the mathematical physicist, by a series of tags known as "quantum numbers."

Further, an edict known as Pauli's principle now decrees that a given series of number tags can belong to, at most, only two electrons. We can regard this series of numbers as the address of the electron in the phantom city of the physicist's imagination. Dr. Mendenhall describes this principle as "social legislation to prevent overcrowding of the electrons," an admirable contribution to electron welfare. Quantum City must be rather dull, however, if it contains nothing but two-room apartments. And physicists used to refer to "free" electrons!

There are two ways in which the electrons can escape from their neatly arranged homes in the metal: (1) By the action of heat. (2) By the falling of a beam of light on the surface.

It is with light that Dr. Mendenhall's experiments have been concerned. This so-called photo-electric effect has played a very important part in reviving Sir Isaac Newton's idea that light consists of particles rather than waves. Only a few electrons, those that have much more energy than the rest, have the privilege of escaping from the metal when the artificial sun of the experimenter comes out. A wall of force known as the "work function" keeps all but a few within the city limits.

The changes introduced by the new theory of metals, due to Professor Arnold Sommerfeld, might be compared to the effects of the industrial revolution. The average energy, or wealth, of the floating electron population is now believed to be much higher than formerly. It is this energy that enables an electron to get around and do things and to escape from the metal from time to time.

Professor Sommerfeld seems at first to have done an excellent thing. It turns out, however, that the dis-obliging wall of force has increased under the new régime to just the same degree as the average energy,

and it is just as troublesome as before for an ambitious electron to break through the surface of the metal and cavort before the waiting experimenter.

Dr. Mendenhall says this is a "protectionist trick by which wages are increased but prices go up correspondingly." These effects, however, influence the electrons on the surface, that is, in the first thousand or ten thousand layers of atoms.

AERONAUTICAL RESEARCH AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

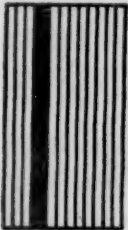
AN artificial windstorm blowing 240 miles per hour has been found possible in the remarkable wind tunnel recently constructed at Pasadena for the California Institute of Technology. The outfit is a feature of the new Guggenheim Aeronautical Laboratory. This terrific velocity exceeds the original hopes of the designers. A wind tunnel enables airplane investigators to reverse the conditions of normal flying with obvious experimental convenience. One simply runs the air past a stationary plane instead of running the plane through stationary air.

The Pasadena tunnel might be likened to a huge reinforced concrete doughnut, flattened to an oval contour and set on edge. The aeronautical laboratory itself is built around the tunnel. The "doughnut" is of course hollow, and varies from ten to twenty feet in cross section. A large direct current motor, mounted in the lower run of the tunnel, delivers 500 horsepower to a propeller. Air is driven in an endless circle to the upper level, where tests are made, and return. A section about thirty-five feet in length along the upper level is accessible to airplane parts and instruments. The investigator watches the hurricane through a curved window. He may then peacefully measure forces, velocities or what-not.

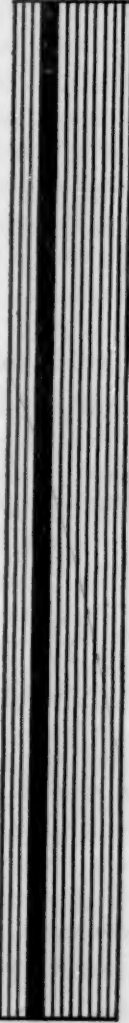
The apparatus was designed by Professor Harry Bateman and Professor Clark Milliken, in consultation with the European expert Theodor von Karman. The latter has now taken residence as director of aeronautical research activities at the institute.

Originally, velocities not much in excess of one hundred miles per hour were expected for this equipment, but practice has jumped ahead of promise. Apparently the air, once in motion, acquires great momentum, and not so much friction as feared. It is not seriously retarded by the tunnel walls. Upon return of the air to the motor after its first round trip it is again accelerated, and its velocity mounts until 200 miles is reached or even exceeded. The smooth interior finish and polished curved steel baffles on the corners permit the air to sneak around turns like a snake, without getting stirred up.

In practice the speed is held down to 200 miles to avoid undue strains. Even then the air becomes hot from friction without thermal relief. Velocity tests at numerous places show that the rate is uniform, not varying



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NEW ANESTHETICS

MORE effective sleep-producing and anesthetic drugs have been produced through research by Dr. H. A. Shonle, of the Lilly Research Laboratories at Indianapolis. The possibility of predicting the duration and the effectiveness of hypnotic sleep-producing drugs that have not yet been synthesized by the chemist is stressed in a report to the American Chemical Society.

Through the use of a new group of anesthetics, known as the amyl ethyl barbituric acids, developed by Dr. Shonle and his associates, it is possible for physicians to reduce the nausea that often follows operations, give the patients greater comfort and subject them to far less mental distress.

These amyl ethyl barbituric acids will not replace ether and other major anesthetics but they find use as substitutes for morphine in making the patient ready for the unpleasant experience of an operation. Since the new compounds are not habit-forming like morphine and other opium preparations, there is no danger of causing drug addicts through their use.

The new drugs are closely related to veronal or barbital, a synthetic compound that has found use in medicine as a sleep-producing drug. Alcohol, which Dr. Shonle calls the "simplest hypnotic," is one of the constitutional parents of the new anesthetics. Part of the alcohol molecule is replaced with barbituric acid, then a part of the barbituric acid is replaced with what chemists know as an amyl group. This makes the anesthetic action more rapid and the patient recovers faster. If plain alcohol were used, fifty times the dose of barbituric acid would be necessary to produce the same hypnotic effect. Veronal is a barbituric acid with two groups of ethyl in its structure instead of the one ethyl and one amyl in the new compounds.

CALCIUM CHLORIDE FOR THE RELIEF OF PAIN

THE intense pain of lead colic, gallstone colic and ureteral colic can be relieved by slow injection into the vein of calcium chloride, a salt of the metal which is necessary for bone formation, Drs. Walter Bauer, William T. Salter and Joseph C. Aub, of the Massachusetts General Hospital, have reported to the American Medical Association. This gives more rapid relief than any other form of treatment tried by these physicians. Their discovery of this new use of a calcium salt and of a way to give relief in these distressing conditions was made in the course of studies on the treatment of lead poisoning.

Lead and calcium, they knew, were both retained in the body in the bones. The chemical behavior of certain

lead and calcium salts in the body are very similar. These facts suggested to Dr. Aub that the same physiologic variations which influenced the elimination and excretion of calcium would similarly influence the lead stream.

Medicines that caused decalcification or removal of calcium from the body resulted in an increased excretion of lead. Conversely, treatment that increased calcium storage also increased storage of lead. Consequently in treating lead poisoning, a high calcium diet is used until all symptoms of the poisoning have disappeared, usually within one or two days. The theory underlying this is that following increased calcium retention as a result of the high calcium diet, the lead is removed from the blood and stored in the bones.

In order to hasten this process and give more prompt relief from the severe pain of lead colic, Dr. Aub and associates tried giving a solution of calcium chloride directly into the veins. The results were dramatic. The pain stopped almost immediately, often before the injection was completed. Such prompt relief made them doubt whether the beneficial action of the calcium salt was due to fixation of lead and calcium salt in the bones. Further studies indicated that the calcium salt acts as an antispasmodic. The mechanism of its action, however, remains unexplained at present.

PSYCHOLOGICAL AGE OF THE OLD

NOT all old people are slow workers. Probably from one fourth to one third of persons over 74 years of age could release the accelerator of an automobile at the approach of danger as quickly as the average adult. And these aged persons differ in speed just as do those who are in their thirties or forties. These facts were among those reported to the New York branch of the American Psychological Association by Dr. Walter R. Miles, professor of experimental psychology at Stanford University.

Dr. Miles has been making a study of "later maturity" at Stanford under a special grant from the Carnegie Corporation. So far he has examined psychologically a total of 800 persons from all walks of life, excepting only the illiterate. A special study of reaction and coordination speed was made for 100 of these selected at random. The ages ranged from 25 to 87 years.

Commenting on the custom of retiring or dismissing an employee who has reached a certain chronological age, Dr. Miles said:

"Age is usually one of the important factors which define physiological and psychological efficiency. No machine can last forever; action necessarily means the reaction of wear and tear. But as the data presented in this paper indicate, there are distinct and measurable efficiency differences between individuals with chronological ages of about seventy years, just as there are differences among people who are in their thirties or forties. The average for all who are older than 74 years, for example, may show a decrement of one fourth

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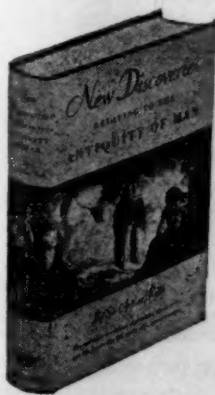
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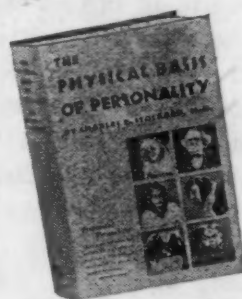
THE PHYSICAL BASIS OF PERSONALITY

During the last few years, Dr. Stockard has been conducting extensive experiments on inheritance and growth in dogs, which have aroused wide general interest. These experiments are producing discoveries of great significance concerning the effect of endocrine secretions on the growth and behavior of individual animals; and the reactions in dogs show results parallel to the peculiar endocrine types of human beings.

On the basis of these experiments, Dr. Stockard presents the known facts concerning the determination of the individual personality by physical agencies—the genes, the endocrine glands, the shape of the brain. The influence of environmental peculiarities on individual development is searchingly examined. There are chapters on The Aspects of Personality; Constitution of the Germ-Cell; Changes in Genes Causing Character Mutations; Embryonic Personality; Critical Moments during Individual Development; Differences Among Children of the Same Parents; Periodic Changes in Personality; Personality Types Among Normal Individuals.

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or one third from the general adult mean. But, on the other hand, one fourth to one third of these old people may still be as capable, in the functions tested, as the average adult, and to check them off just because they happen to have been born seventy or more years ago may be as unfair to the individual as to drop him because he was born of foreign parents.

"Psychologists have convinced themselves and the educational world that there is such a thing as mental age, which, although it may ordinarily run a parallel course with chronological age, does not do so in all cases. And for this reason individuals must be considered, rather than arbitrarily lumped in calendar-year units. Investigation such as is reported by the present sample of data indicates that calendar worship should be further curtailed as related to the problems and adjustments required in human life at its stage of later maturity."

The measurements of speed were made by an ingenious electrical device which not only timed the movements made by the persons tested, but also gave the signal to which the person was to respond. It times as closely as a one-hundred-twentieth of a second.

BIRDS IN EUROPEAN REFUGES

FROM many lands in Europe come encouraging reports of the increase of birds, notably on islands and in restricted areas set aside for sanctuaries and breeding grounds. The response of some hard-pushed species to protection gives good hope of their survival, and even for some degree of restoration.

One very notable bird paradise is the salt-marsh region of the Camargue, at the mouth of the Rhone in southern France. One bird that breeds here, the stilt, is found all the way from Spain to southern Russia. Here also may be found numerous nests of the flamingo, whose only other European breeding-place is in Spain.

New refuges have been opened up in Germany also. On one dune-covered island off the coast of Schleswig, where thousands of sea-birds breed, the number of nests has almost doubled since 1927, when the area was set aside. On the west coast of Schleswig-Holstein there are a number of tide-swept islands known as "Halligs" that make ideal homes for birds, particularly avocets. These have also been set aside as national bird sanctuaries.

In a reedy marshland in Holland, known as the "Naarder Meer," on the south shore of the Zuyder Zee near Amsterdam, two notable and very rare species make their home. These are the purple heron and the spoon-bill. Of the former there are about 70 pairs, and of the spoonbill about 125 pairs.

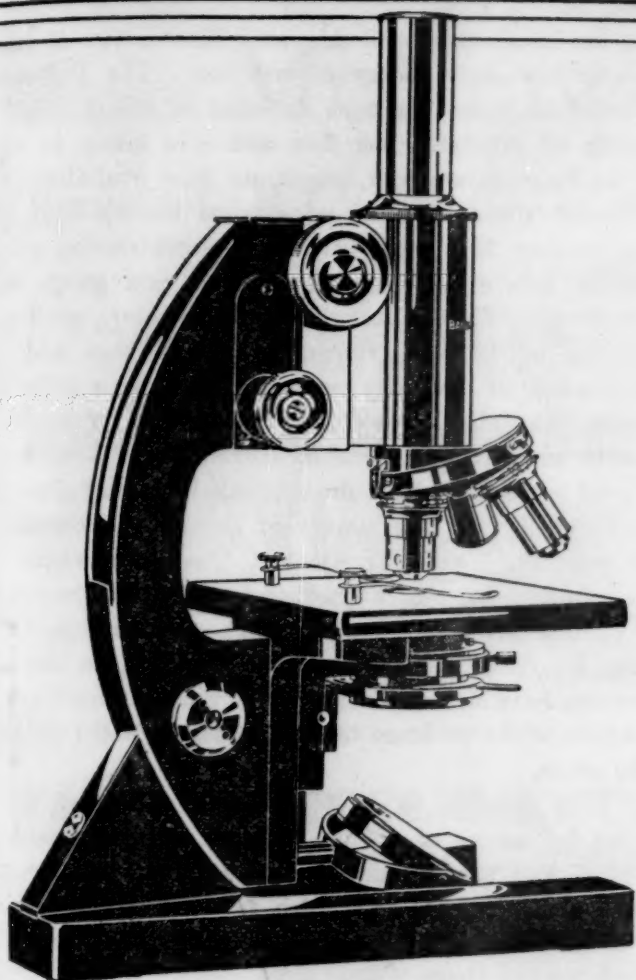
Far to the north, in the Arctic Ocean west of Finland, is a great colony of puffins. They pretty much possess the land, and burrow their nests down into the earth to more than arm's length. But they have their troubles. They are persecuted by two species of gulls, one of which attacks them bodily and often kills and eats the puffins, while the other species, the Arctic long-tailed gulls, robs them of their legitimately acquired prey of fish.

ITEMS

MUSIC, when heard at a distance, has an entirely different quality on a dry day from that on a humid day. Experiments by Dr. Vern O. Knudsen, acoustic expert of the University of California at Los Angeles, show that sounds of high pitch can travel much farther in moist air than in dry air. The frequencies of sound most affected by atmospheric moisture are those from 2,000 per second upward. These include the two topmost octaves of the piano. Sounds of middle and low pitch, such as the principal tones in the human voice range, are hardly affected at all. This phenomenon is of concern principally in a very large auditorium. For example, a rear-seat auditor in the famous Hollywood Bowl might be listening to an orchestra 550 feet away. At this distance the high notes will be as much as ten times as loud in humid weather as in dry. Since the lower tones penetrate regardless of weather, there will be a great difference in the relative energies of tones of different pitch which strike the ear.

FIRE, avalanche, windstorms tearing down great swaths of forest—these are the path-clearers for the great thickets of rhododendron, mountain laurel and other fine shrubs whose beauty arouses the admiration of visitors to the Southern Appalachians. These plants, members of the heath family for the most part, go into such devastated areas and hang on there, in spite of the poverty of the soil and constant winds that try to suck the life-sap out of their leaves. This, in brief summary, is the story of a study of the "heath balds" of the Great Smoky Mountains recently concluded by Dr. Stanley A. Cain, of Butler University. The "balds" and "slicks" of these mountains are composed of thick tangles of shrubs, which in the blossoming season are often very beautiful. Dr. Cain found in many studies of the soil that a little digging would always disclose a layer of charcoal, even if the surrounding forest showed no signs of fire in past years.

A NEW fertilizer crop that promises well for the sandy, nitrogen-poor soils of Florida and other southeastern states, has been found in several species of *Crotalaria*, more familiarly known as rattle-pod and rattlesnake weed. It is a member of the legume or pea family, and has the same kind of bacterial nodules that grow on the roots of peas and clover, capturing nitrogen from the air and making it available for the use of higher plants. There are about 600 species in the genus *Crotalaria*, of which five are native to the eastern United States. The species tried out in Florida are partly native, partly imported from South America. The plant gets both its common and its scientific names from the hollow pods of many of the species, in which the seeds rattle when blown by the wind, giving a sound suggesting the buzzing of a rattlesnake. The scientific name of the rattlesnake genus is *Crotalus*, whence *Crotalaria* for the plant.



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OCEAN CIRCULATION

THAT water in the Pacific ocean circulates more slowly than it does in the Atlantic, is the conclusion drawn from the amounts of oxygen found in water samples collected by the ill-fated, non-magnetic ship, *Carnegie*, of the Carnegie Institution of Washington.

This discovery was announced at the recent Washington meeting of the American Geophysical Union by J. A. Fleming, acting-director of the Department of Terrestrial Magnetism of the Carnegie Institution.

A gasoline explosion, in the harbor at Apia Samoa, two years ago, caused the complete burning of the *Carnegie*, veteran of many scientific expeditions around the world. Fortunately for the present investigations, complete records and samples of the cruise had just been shipped from Pago-Pago in American Samoa and were in the mails at the time of the disaster.

Analyses of the oxygen content of the sea at different depths were made throughout most of the Pacific ocean. The deep-sea water of the Pacific was found to contain much less oxygen than previous oceanographic observations have shown to be in the deep-water of the Atlantic.

"From this it was concluded," said Mr. Fleming, "that the deep-water of the Pacific has lacked contact with the atmosphere for a longer period than the Atlantic deep-water. This is either because the Pacific water flows at a slower rate or is farther removed from its sinking center."

Oxygen gets into the water in two ways. It is either dissolved from the air or formed during photosynthesis, the process by which marine plants build themselves up with the help of the sun's rays. Four separate layers of water were readily recognized from the oxygen amounts. There is a layer of high oxygen-content near the surface, followed by one containing the maximum quantities where photosynthesis occurs. Below this the oxygen decreases to a minimum at about 700 meters. In the fourth and lowest layer the quantity of oxygen increases slowly with increasing depth but is always considerably less than at the surface. Unusual currents upset the regular sequence of these layers.

Temperature variations and determinations of the amounts of phosphates in the water also showed the existence of local currents.

The work of compiling and interpreting the results obtained by the lost ship is now far advanced but is not yet completed.

WEATHER CYCLES

A WEATHER cycle, first observed by noting the years when good and bad wines were made, will tell the flow of the Colorado River during the next ten or twenty years, according to A. F. Gorton, of the Scripps Institution of Oceanography, La Jolla, California, speaking before the American Geophysical Union.

For huge water-storage projects like the Boulder Dam it is becoming increasingly necessary to be able to fore-

cast far in advance, and this, said Mr. Gorton, is promised by the cycle theory of weather. The Brueckner cycle of 22 years has been detected in recent years in records of rainfall, river flow and lake levels, in spite of the fragmentary and inaccurate data available.

Several thousand years of climate history have now been written from observations of eccentricities of the weather before the thermometer and rain gauge were introduced. Floods, droughts, severe winters, prolonged freezing of harbors, rivers, lakes and seas and the devastation of hot, dry summers have been noted by people throughout history. From this dramatic if slender narrative the essential correctness of Brueckner's 22-year period has been demonstrated successfully.

"Coupled with this history of recurring anomalies of the weather," said Mr. Gorton, "we have vague but persistent evidence of a gradual drying-up or desiccation of climate in certain regions, such as Mongolia, Tibet, Iraq, Northern Africa, Peru, Mexico and, in our own country, New Mexico at the site of the cliff dwellers. In most cases the evidence of desiccation is based on lower lake levels.

"It is possible to establish the existence of certain cycles by means of official Weather Bureau records of rainfall and temperature, although in no case are they older than sixty years. Also fairly accurate observations have been made in the older cities of the East since revolutionary times."

Rainfall records from both the east and the west coasts of this country show the Brueckner cycle, though the crests of the curve or years of maximum rain are completely out of step. The floods of the Murray River, in Australia, show the same periodicity, but there is a six-year difference between southern Australia and southern California.

Rainfall and stream flow on the west coast show other regularities, of two to three years, five and one half years, and eleven years. All these cycles are deducible from the periods of fluctuation of sun-spot numbers and are simply related to the longer Brueckner cycle.

From facts of this kind it will be possible to make forecasts of the trend of precipitation up to twenty-five years. The value of such predictions to agricultural, economic and financial interests, not to mention the large utility companies, can hardly be overestimated.

EFFECT OF ULTRA-VIOLET LIGHT ON COMETS

GREAT outbursts of ultra-violet light from the sun may press so hard on the tail of a comet as to break it in two. This is the theory presented before the American Geophysical Union by Dr. H. B. Maris, of the U. S. Naval Research Laboratory.

The curious fact that sunlight can cause such huge pressures as this is at the basis of Dr. Maris's new theory of the irregular variations of brightness observed in comets. During periods when many sun-spots are

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visible, the ultra-violet light streaming out from the sun may increase as much as a thousand times.

The atmosphere of a comet is transparent to visible light but strongly absorbs ultra-violet light which, because of this absorption, exerts a pressure on it. The effect on the comet is to create a strong wind in its atmosphere moving away from the sun. Thus that part of a comet that feels the pressure most may get a violent jolt when a new whirlpool appears in the sun.

Magnetic storms, those great fluctuations of the earth's magnetic forces, often accompany or anticipate the unusual changes in comet activity. Since the magnetic effects are known to be due to the ultra-violet surges associated with bright spots on the sun, this forms additional support for the new theory of comet behavior.

Comet activity shows itself by changes in the brightness of the atmosphere of the comet, similar to those observed on the earth during a display of the aurora or northern lights. The aurora is caused by increased ultra-violet light from the sun. It occurs at the same times as the magnetic storms.

Dr. Maris studied records of the great comets of last century. He found that the splitting of a comet was accompanied or preceded in nearly every case by a great magnetic disturbance on the earth. The great comet of 1882 met a tremendous solar disturbance at the time of its approach to the sun. Dr. Maris believes that this was the cause of its subsequent disruption.

THE EFFECT OF MOONLIGHT ON RADIO RECEPTION

MOONLIGHT, like sunlight, interferes with the successful reception of radio, according to the report of Dr. Harlan T. Stetson, of the Perkins Observatory, made to a joint meeting of the American Institute of Electrical Engineers and the New York Electrical Society at the Ohio Wesleyan University.

The strengths of signals between Chicago and Boston for the last few years have been analyzed by Dr. Stetson and found to be received about one hundred per cent. better when the moon was below the horizon. This is believed to be due to a negative electrical charge on the moon.

The unfavorable influence of the moon on the reception of radio waves of 4,000 kilocycles has also been independently established by Lieutenant H. F. Breckel, of the U. S. Navy Department, in Cincinnati. Lieutenant Breckel worked without knowing of the Perkins Observatory experiments.

Radio waves travel long distances only because they are reflected from a layer of electrified particles lying in the upper atmosphere about seventy miles from the earth. This radio mirror, called after its discoverers, the Kennelly-Heaviside layer, is pushed down towards the ground when the moon is passing overhead.

This produces somewhat the same sort of disturbance in radio transmission as that produced by sunlight. "The sun constantly bombards the earth's atmosphere with electrons or bundles of energy of high frequency," said Dr. Stetson. "These in turn tear apart the positive

and negative charges of the atmospheric molecules. . . . If the sun is more active on occasion, as when large spots appear on its surface, the degree of ionization increases, producing substantially the effect of lowering the Kennelly-Heaviside layer and upsetting the radio reception. . . . Recent investigations in the field of correlation of radio reception with astronomical phenomena point now to the radio receiver as a valuable instrument of research in cosmic physics."

The decreased strength of reception at present over that experienced in the early days of broadcasting and the vastly poorer reception in the day time compared with night time are both due to the changing effect of the sun's rays on the earth's atmosphere. In addition, however, both day and night reception vary greatly from time to time for what has often seemed no good reason at all. We have come to believe much of the cause for this varying degree of reception is to be found in the sun's atmosphere itself.

The gigantic cyclones in the sun, which we see as sun-spots increasing and decreasing every eleven years, are now found to be the cause of the changes of the electrical state of the atmosphere and thus of the clearness of radio reception.

METALLIC ZINC

A REVOLUTIONARY new process for producing metallic zinc of unusual purity from the concentrated ore, which is expected to find wide application because of its economies, has been developed by the U. S. Bureau of Mines.

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The development was described to zinc miners and engineers at the meeting of the American Zinc Institute, in St. Louis, by R. S. Dean, chief engineer of the Metallurgical Division of the Bureau of Mines. It was devised by Charles G. Maier, metallurgist at the Pacific Experiment Station of the bureau in Berkeley, California.

Mr. Maier first showed by mathematical calculation that pure zinc could be obtained from the ore by methods better than current practice. He then proved in the laboratory that his theoretical reactions were correct. Next, an experimental zinc smelting plant employing the new process was set up in the Rare and Precious Metals Experiment Station at Reno, Nevada, in which the method worked out by theory was tried on a practical scale and found to be successful.

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—H. Sydow in *Annales Mycologici*.

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YELLOW FEVER AND AIR TRAVEL

THE possible spread of yellow fever by air travel was discussed at the recent Pan American Conference of directors of health, meeting in Washington.

New discoveries have shown that control of yellow fever is not so certain as it once appeared, and the speed of air travel adds greatly to the hazards which public health officers must fight in keeping down this disease.

The discovery that thirteen varieties of mosquitoes, instead of one, are susceptible to yellow fever and may spread the disease, complicates the situation enormously. It means, among other things, that countries which thought themselves safe because they were fighting the *Aedes aegypti* mosquito are no longer safe. India, for instance, with its teeming millions of uneducated people, has so far been free of the disease. But the mosquitoes capable of transmitting it exist in India, and just one unsuspected or uncontrolled yellow-fever patient might start an epidemic of horrible proportions.

Another disturbing discovery has shown that many people have such light cases of yellow fever that it is not recognized. They may actually become unrecognized carriers of this disease for a short time. A new test, devised by investigators of the Rockefeller Institute, shows whether or not you have had yellow fever. If you have had it, serum from your blood injected into monkeys or white mice will protect these animals from the disease when its causative germ is injected into their bodies. But this test is not quick, and the best method of protection still remains effective quarantine against yellow fever. The health authorities at this conference expect to work out improved methods for such quarantine.

ITEMS

A NEW low in the measurement of extremely small lengths was announced by Professor Arthur H. Compton, at the Washington meeting of the American Physical Society. He has measured the length of waves in the X-rays correct to the five hundredth part of the diameter of a single atom. In inches this length is much lower than we can conceive. It is the hundred thousandth part of the millionth of an inch. The wave-length itself measured by this process was about 700 hundred atom diameters, and was thus known with an accuracy of one part in 300,000. The measurement is made with an instrument known as a double X-ray spectrometer. In a spectrometer the rays fall on a crystal which breaks them up into their constituent vibrations. By noting the angle at which these leave the crystal, the wave-length, that is the distance from crest to crest of the vibrations, can be estimated with extreme accuracy. A double spectrometer, a recent refinement, is even more powerful in searching out these small distances.


THE mile-long tube at Pasadena, California, to be used by Dr. Albert A. Michelson, of the University of Chicago, for his new determination of the velocity of light, has had its length measured to an accuracy of one part in a million. The result was announced to the

meeting of the American Geophysical Union by Dr. William Bowie, chief of the division of geodesy of the U. S. Coast and Geodetic Survey. The measurement was made by Mr. Clem L. Garner, assistant chief of the same division. The tube is approximately 1,594 meters in length. The 50-meter tapes used in the measurement were made of invar, a metal which changes its length very little with changes in the temperature. They were standardized at the U. S. Bureau of Standards in Washington. The air will be removed from the tube for the speed measurement. The velocity of light in a vacuum will thus be found directly for the first time on the surface of the earth.

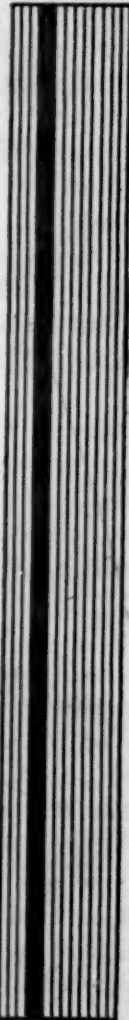
If astronomers peering through their telescopes see bright clouds of hydrogen on the surface of the sun, they can tell that on the following day the sensitive magnetic needles of their observatories will quiver and move from their true position. This prediction, now possible as the result of a discovery by Dr. G. E. Hale, of the Mount Wilson Observatory, was announced at the meeting of the American Geophysical Union by Dr. Seth B. Nicholson, of the same observatory. Dr. Hale has found that exceptional magnetic storms on the earth occur a little over one day later than the flaring of the hydrogen. He has collected accounts of several extraordinary outbursts of this nature which were followed by exceptional magnetic disturbances on the earth. The hydrogen clouds occur in or near active groups of sun-spots and show rapid changes. The sun-spots themselves are darker than the surrounding surface of the sun.

How tree and shrub associations over a countryside may be used to make a rapid survey of the kind of rocks that lie beneath, is told by Dr. Robert H. Cuyler, of the University of Texas, in a report to the American Association of Petroleum Geologists. Dr. Cuyler found, in a study of various geological formations in Texas, that each type of rock formation had a distinctive type of vegetation growing on it. One formation supported woods in which a species of oak predominated, another was covered with a juniper forest, a third was marked by mesquite thickets. Two maps of a selected region, one showing only the vegetation and the other only the rock formations, are found to be divided up into areas that correspond very closely in size and shape. Dr. Cuyler believes that with the use of aircraft it will be possible to make very rapid geological reconnaissances of new territory.

RESIDENTS of Marseilles recently had the experience of actually looking "around the corner" of the earth when they saw Mt. Canigou, 157 miles to the west, silhouetted against the setting sun. Actually, the straight line joining the peak with Marseilles passes almost 400 feet below the surface of the Mediterranean. However, the atmosphere of the earth refracts the rays of light around the curved surface. In February and October the sun sets behind the mountain, as seen from here, and then the effect can be observed.



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SCIENCE NEWS

Science Service, Washington, D. C.

CANCER AND BLOOD ALKALINITY

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STUDIES of significance on the cancer problem have been reported by Dr. Ellice McDonald, director of cancer research at the University of Pennsylvania Graduate School of Medicine, and his associates, Gladys E. Woodward, Janetta W. Schoonover, Edith G. Fry and Edward G. Torrance.

The blood of patients with untreated cancer is more alkaline than normal, they found. This increased alkalinity seems to be related to the speed with which the disease will kill the patient. "The greater the alkalinity, the quicker the disease kills," said Dr. McDonald. Treatment by X-rays or radium, which may cure or at least retard the disease, affects the alkalinity of the blood.

These observations, reported in the forthcoming issue of the *Journal of Laboratory and Clinical Medicine*, indicate that in the condition of the blood may be found a means of predicting the course of the disease and the success of treatment. Likewise a new method of treatment may be developed which would turn out to be the long-sought specific cure for this dreaded malady. The important point is that environmental conditions outside the cell influence the course of the disease.

Cancer is a disease in which cell growth is abnormal. Cancer cells have been called wild cells because of their erratic growth. Investigators have been studying the cells microscopically and with moving picture cameras in the hope of finding what makes some cells turn into the wild cancer cells. It appears from Dr. McDonald's report that the cause of their erratic growth is to be sought outside the cell, in the surrounding tissues and in the blood.

"The state of the blood in cancer is of great importance because cancer becomes a systemic disease and cancer cells receive their nourishment from and give off their waste products to the blood," his report begins. "Therefore it is to be expected that the blood of cancer patients should differ from normal blood."

The difference, Dr. McDonald and associates found, is in the degree of alkalinity. The average alkalinity of the blood in the 26 untreated cancer patients studied was 13 per cent. above the normal. The alkalinity of blood or other biochemical solutions is determined by measuring the concentration of hydrogen ions. This is called in the chemists' shorthand, pH.

"Alkalosis of the blood plasma of untreated cancer patients seems to have a bearing upon the duration of their lives, or duration of life is a function of pH. In the series, the more alkaline the blood plasma of untreated cases, the worse the prognosis. Warning should be given in applying this rule to patients whose pH may be modified by treatment, complications or medication," Dr. McDonald's report stated.

The diagnosis of cancer in the patients of the study was confirmed by examination of a small piece of tis-

sue removed from the tumor, or by post-mortem examination of the patient's body.

"This is very far reaching in the future study of cancer," according to Dr. McDonald. "In marine eggs, if the balanced sea-water is made more alkaline, the rate of division and multiplication is increased and *vice versa*. The analogy holds for cancer and the obvious is to attack the disease through the blood or environing fluid, which may have some hope of success."

THE USE OF WOOD ALCOHOL

SAFEGUARDING the public health from possible deleterious effects of methanol, or wood alcohol, used as an anti-freeze in automobile radiators was recommended in a resolution passed by the Conference of State and Territorial Health Officers with the U. S. Public Health Service. The resolution was based on the following report of the committee appointed by Surgeon-General Hugh S. Cumming at the opening session of the Conference:

"Your committee has considered the matter of the increasing use of methanol as an anti-freeze in automobile radiators and in industry and feels that the use of this substance should be surrounded by the necessary safeguards through agreement of the Public Health Service with the industry.

"If such an agreement can not be reached, the Surgeon-General is requested to inform the several state departments of health of that fact and suggest to them such standard safeguards as he deems necessary for the protection of the public health as a basis for state laws and sanitary regulations."

The report was signed by Dr. S. H. Osborn, chairman of the committee and state health officer of Connecticut, and by the committee members as follows: Dr. T. B. Appel, state health officer of Pennsylvania; Dr. A. J. Chesly, state health officer of Minnesota; Dr. R. H. Riley, state health officer of Maryland, and Dr. J. P. Leake, of the U. S. Public Health Service.

The safeguards necessary to protect the public health from this new menace will be based on the findings of investigations now being carried on by the U. S. Public Health Service. These will be announced at the completion of the studies.

Methanol, or wood alcohol, is a poison which may cause blindness and death if taken internally. According to some authorities it is equally poisonous if inhaled or absorbed through the skin. A cheap method of making it synthetically has made it practical for use as an anti-freeze. Public health authorities are now trying to determine how to eliminate the dangers from the wide use of so potent a poison.

DROPS ACTING LIKE LIVING CELLS

DROPS of lifeless solution, suspended in another solution equally lifeless, can act as though they had life in them. They will increase in size, then divide, and the

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"offspring" drops in their turn grow and divide again.

The possibility of this and other lifelike behavior was demonstrated on mathematical grounds by Dr. N. V. Rashevsky, of the Westinghouse Research Laboratory, East Pittsburgh, Pennsylvania, before the American Physical Society. Dr. Rashevsky has not carried out experiments to demonstrate his theory, but the principles he laid down may be the general explanation for such special cases of "artificial cells" as those shown by Dr. George W. Crile, at the Cleveland meeting of the American Association for the Advancement of Science, last winter.

The growth and division of the imaginary, artificial, lifeless cells were all accounted for by Dr. Rashevsky on the simplest of physical assumptions. That a cell may keep its shape intact through several changes was also explained without considering any of the complicated structure actually occurring in the living cell.

"One of the most fundamental phenomena of life, if not the most fundamental one," said Dr. Rashevsky, "is the multiplication of a cell through division. All the facts of growth and multiplication of more complicated and highly developed organisms reduce in the last analysis to the growth and division of single cells."

Instead of attempting to give a detailed theory of such complicated phenomena, Dr. Rashevsky decided to investigate first some intentionally over-simplified cases, which are never found directly in nature. It is through the study of intentionally over-simplified arrangements that finally remarkable progress has been achieved in other exact sciences outside of biology.

"Let us for a moment forget about actual living cells," Dr. Rashevsky said, "and investigate mathematically whether it can happen, and, if so, how it can happen, that a small liquid drop will spontaneously divide into two parts.

"It is found that such spontaneous division can not occur, if the drop is in a perfectly resting state and is not undergoing any changes. "Consider the case that a drop, which is surrounded by another liquid, interacts chemically with this liquid, so that the amount of liquid which constitutes the drop increases, just as would be true with a small organism. If the drop thus grows at the expense of certain substances, contained in the surrounding liquid, then under some very general conditions, the drop will divide into two on reaching a certain size. Each half will then again grow up and again divide and so on."

Generations of droplets showing an evolution to more and more complicated chemical constitution can thus be formed without the interference of the experimenter, Dr. Rashevsky's theory indicates. This happens when the intervals between the successive divisions are unequal.

If the drop is below a certain minimum size, it will not grow but dissolve away. Thus in no case can an imitation droplet-cell be formed spontaneously. On the other hand the number of drops may increase continuously through the process of division and subsequent growth, as long as substances necessary for this growth are contained in the surrounding liquid. "Life" persists so long as "food" is available.

EXCESS FAT OF BODY CHANGED INTO SUGAR

If you eat too much fat and not enough sugar, will your body automatically transform some of the excess fat into carbohydrate fuel food? Dr. John R. Murlin, of the University of Rochester, has suggested that the versatile human body thus answers its own demands for proper food by manufacturing the needed sort even if the raw materials fed it are not just what are needed.

Volunteers lived on a diet of pure cream for five days in the experiments reported to the Federation of American Societies for Experimental Biology, by Dr. Murlin and Miss Estelle E. Hawley, his associate. Each morning and evening they were fed their meals of cream and then they were put through tests to ascertain how the body used this unbalanced food ration. One brave temporary martyr to science remained in an ice box for an hour and a half in order to test his metabolism on the fat diet under the influence of reduced temperature. He shivered for an hour during this experience.

Sufferers from diabetes seem to be able to eat fat without filling their blood with sugar that is dangerous to them. This has caused physiologists to believe that the body could not manufacture sugar or other carbohydrates from fatty foods.

Physicians have recognized heretofore that sugars could be converted into fat by the body and they have repeatedly warned pleasantly plump people against eating too much sugar and starches. Now, if Dr. Murlin's experiments are further confirmed, they can feed their obese patients high fat diet in necessary cases with the assurance that the body will look out for itself and make the sugar that it needs to supply its energy.

WILDFLOWER SANCTUARIES

ESTABLISHING sanctuaries and protected areas for threatened wildflower species is not enough to insure their survival. The special needs of the plants, especially their soil preferences, must be studied and adjustments made accordingly.

So said Professor Edgar T. Wherry, in a radio address delivered under the auspices of *Science Service* recently. The talk was broadcast over the network of the Columbia Broadcasting System. Professor Wherry said, in part: "Before extensive transplanting of wildflowers into such preserves is undertaken, some study must be made of the soils existing there, and the requirements of the individual species concerned. There will be no use trying to grow trailing arbutus or moccasin flower for instance, in a patch of neutral or alkaline soil, as such plants are sure to die in a year or two unless an acid-reacting humus soil is provided in the first place, and permanently maintained in that condition. And it will not do to jump at the conclusion that a soil is acid just because moss is growing on the ground, or lots of dead leaves are strewn around. The only way to be certain that the acidity is high enough is to make tests with indicators, that is, dyes which change their colors with different degrees of acidity and alkalinity.

"Some provision must also be made to exclude weeds. I once was invited to look at a wild garden which had

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been laid out on a large estate at considerable expense, in which, so I was informed, there had been planted hundreds of attractive and delicate spring flowers. When I reached the spot, I saw there a most luxuriant mass of poison ivy, and only after some search was I able to discern a few miserable hepaticas and trilliums fighting a losing battle to maintain themselves. The owner refused to spend the additional sum which would have been necessary to employ a gardener with enough knowledge to keep down the weeds without injuring the introduced native species and so succeeded only in preserving some plants which needed no protection whatever. Remember that a wild garden must be weeded quite as much as a cultivated one, and count on employing some one sufficiently acquainted with native plants to be able to tell the weeds from the flowers."

CONSERVATION OF WILD LIFE IN AUSTRALIA

AUSTRALIA, which has had a development more or less analogous to that of the American West, is now passing through a phase also experienced in America—the realization that reckless slaughter is threatening extermination of many of its unique animal species. This is resulting in activities looking toward their protection and preservation.

The koala or "native bear," an animal looking more or less like a bear but really a marsupial related to the kangaroo and the opossum, is an object of special solicitude. In New South Wales and other regions where it has been exterminated, efforts are being made to reintroduce it.

The so-called marsupial wolf or thylacine, not so harmless and good-natured as the koala, has been mercilessly hunted and now survives only in northwest Tasmania. The Government of Tasmania has lately taken steps to protect the survivors of the species, and now forbids the exportation of thylacine pelts.

The Australian opossum is another animal that is being over-hunted. In the state of Victoria alone, which has a three-month open season, at least one million are killed annually, and conservationists are becoming concerned lest the fur trade destroy itself through its own over-eagerness for profits. New South Wales is the only state where the opossum is given official protection.

Although there are laws on the books to protect the native animal and plant life of Australia and Tasmania, there are not enough rangers in service to secure proper enforcement. However, voluntary assistance of interested persons is now being enlisted; and there is a movement on foot to establish nature sanctuaries and parks.

ITEMS

WITH a series of eight earthquakes, culminating in the destructive Caucasus shocks at the end of the month, April has maintained the high earthquake record of the first quarter of 1931, and has followed the example of the preceding month, which ended with the wrecking of

Managua on March 31. The total of major earthquakes for the year, up to April 30, now stands at 43. Last month's quakes occurred on April 4, 6, 15, 19, 20, 22, 24 and 27. The last date was that of the destructive quake in the Caucasus region, though the telegraphic reports of it did not come out from Moscow until the twentieth. None of the other seven quakes, fortunately, caused any notable damage to life or property. One, a very mild one, rattled dishes and doors and cracked a few ceilings in the Hudson and Mohawk valleys in New York State. This was on the twentieth. The second and third quakes of the month, on the sixth and fifteenth, respectively, were mid-ocean earthquakes on opposite sides of the earth. The first agitated the Pacific Ocean bottom almost on the equator, in the neighborhood of the Caroline Islands, and the second occurred in the Atlantic, a little west of the Azores.

COAL mining accidents that only injured miners and did not kill them are being studied by the U. S. Bureau of Mines. This does not mean that the Bureau of Mines neglects to study fatal accidents, but rather that it is extending the scope of its studies to include both fatal and non-fatal accidents in an effort to lower the figures of 100,000 men injured and 2,000 killed each year in the coal fields. Reports have already been received from about half the operating companies on non-fatal accidents that occurred in 1930.

THE interior of the human ear can now be photographed with a new camera developed by Dr. Richard Millar, director of the photography division of the Methodist Hospital of Indianapolis. The ear camera is hailed by the medical world as a distinct step forward in the treatment of ear diseases. For the first time in medical history a pictorial record of different stages of ear diseases can now be kept. The camera takes pictures 120 times as large as the inner ear. With the use of a special concave mirror, a powerful beam of cold light is focused ingeniously into the patient's ear. The exposure is made through a hole in the center of the reflecting mirror which is turned to deflect the light from the lens of the camera. Heat is extracted from the light beam by passing it through a flat glass flask filled with ice water before it reaches the ear.

A BIRD that displays something of the languor of the tropics is described by Dr. T. A. Jagger, director of the Hawaiian Volcano Observatory. The malau bird, a unique inhabitant of Niuafoou, one of the Tonga Islands, digs a hole three to five feet deep in the slope of the warm volcanic sand, lays her long, pink egg in the bottom, scratches her way out, filling the hole behind her with sand, and lets nature do the rest. The sun heats the sand to from 85 to 95 degrees Fahrenheit. If the natives do not molest the egg and it is allowed to hatch, the young bird digs its own way out. The egg is the size of that of a goose. In another effort to save labor, different hens reoccupy the same holes over and over.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE LAST MISSING CHEMICAL ELEMENT

It is claimed that the one remaining unknown chemical element, number 85, has been detected for a first time in sea-water, potassium bromide, and in a number of well-known minerals by a method of super chemical analysis so delicate that it can recognize one part in a hundred billion of water.

The discovery is announced by Dr. Fred Allison, Edgar J. Murphy, Professor Edna R. Bishop and Anna L. Sommer, working at the Alabama Polytechnic Institute. Two of these, Dr. Allison and Mr. Murphy, are the same scientists who a year ago discovered the next to the last unknown element, number 87, next-door neighbor to radium in the chemists' table of the ultimate building blocks of matter. Ninety-two elements now form the completed list. The new element, the 85th when the elements are arranged in the order of the weights of their atoms, is a family relative of iodine, long popular as an antiseptic. It has not yet been separated, for only one part in a billion is present in the substances examined.

However, in their letter to *The Physical Review*, in which the announcement is made, the discoverers say that concentration of a purer form of the element from monazite sand, is being attempted and is making good progress. The "eka-iodine," as Mendeleeff would have called it in his original periodic table, is being separated as the "85-ite" of lithium. Monazite sand is well known as the source of the cerium and thorium used for the mantles of Welsbach gas burners.

Other materials in which number 85 has been found are: Kainite, a potassium magnesium sulphate found in the famous German Stassfurt salt deposits; apatite, which is a fluoride and phosphate of calcium and barium and fluorite, or calcium fluoride, as well as in the laboratory reagents hydrofluoric and hydrobromic acids.

An unexpected fact is noted that the acid formed from the new element, "85-ic" acid, does not show itself when nitric and hydrochloric acids, bromine and iodine are added to the solution, but reappears when so-called reducing agents such as the dioxide of sulphur are present.

The new method of analysis depends on a strange phenomenon discovered a long time ago by Michael Faraday. The Faraday effect has to do with what happens to a beam of light passing through a transparent substance placed between the north and south poles of a powerful magnet. The vibrations of the light beam, if polarized, that is, confined to one direction to start with, are found to have rotated on passing through the magnetised liquid.

About a billionth of a second elapses after switching on the magnet before the influence on the light vibrations is observed in the liquid. This lag is found by Dr. Allison and his associates to be different for different substances. It is this delay that gives a means of identifying extremely small amounts of substances and in particular the first traces of the new chemical ele-

ment 85. Because of its small amount the lag was not discovered until a year or two ago when Dr. Allison invented his new method of measuring it. No satisfactory explanation of the phenomenon can be given on present theories, a fact which adds still further to the scientific interest of the work.

America seems to be making up for lost time in discovering the missing members of the chemical family. Until the discovery of illinium by Professor B. S. Hopkins at the University of Illinois in 1926, no element had first shown itself to an American investigator. Illinium's discovery left only two more elements to be discovered in order to complete the chemical periodic table, that great generalization first discovered by the Russian chemist Mendeleeff in the 1870's.

If the discovery of element 85 is confirmed by other investigators, the United States will have the distinction of having found the three last and therefore the most inaccessible of all the elements. Six elements have been discovered in the last seven years. Number 72, called hafnium after the city of Copenhagen, was discovered in 1923 by Professor D. Coster and Dr. Georg Hevesy. Numbers 43 and 75 were isolated in 1925 and 1926 at the University of Berlin by Dr. Walter Noddack and his collaborators and named masurium and rhenium.

STATIONS FOR THE STUDY OF METEORS

SPECIAL observing stations will be established by the Harvard College Observatory near the site of the Lowell Observatory at Flagstaff, Ariz., and two astronomers will continually watch the sky throughout the nights in order to record for science the meteors that constantly bombard the earth's atmosphere from outer space. Plans for this expansion of the Harvard College Observatory's work were announced by Dr. Harlow Shapley, director. The actual observations will begin about October 1.

Dr. Ernst Öpik, astrophysicist at Harvard, this year on leave of absence from the University of Tartu in Estonia, and Professor S. L. Boothroyd, of Cornell University, will join with Dr. Shapley in the research.

"One of the principal aims of the expedition is to determine the frequency of meteors throughout the year, and a second important aim is to determine their altitude in the earth's atmosphere," Dr. Shapley said. "In order to measure the height it will be necessary to work at two stations, separated by approximately twenty-five miles. At each station two observers will continually watch the sky throughout all the hours of darkness except when the weather and strong moonlight interfere. At each station one observer will observe the northern sky and the second the southern sky. In my opinion the meteors, which have been much too neglected by astronomers, are of high importance in problems of the upper atmosphere of the earth, the relation of meteors to comets, the nature and abundance of interstellar material, and in other problems of cosmic significance."

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In addition to the naked eye observations of meteors for numbers and distribution through the night and throughout the year, and for measures of the height, an attempt will be made to determine the velocities of some of the meteors and to develop further the photography of such objects.

Meteors, or shooting stars, are small pebbles or dust grains speeding at twenty to thirty miles per second in the Earth's atmosphere at an altitude of forty to eighty miles. Only those of great brightness are recorded on photographic plates and the human eye can see those nearly one hundred times fainter.

Dr. Shapley predicts that in a year there will be accumulated more satisfactory material on meteors than has ever been collected before.

ADVANCES IN METEOROLOGY

CHASING clouds in an airplane, to learn how fast they grow and to obtain other intimate secrets, is the new kind of meteorology that was described before the Washington meeting of the American Meteorological Society, by Dr. J. B. Anderson, of the Naval Air Station at Anacostia, D. C.

Dr. Anderson wanted to learn something about the birth and growth of clouds in the more or less permanent layer that hangs over the Pacific coast of the United States. He was especially curious to find out the rate at which they piled themselves up into the air. He found that to keep his plane even with the top of one cloud he was studying he had to climb two or three hundred feet in a minute.

How to get other weather data from the upper air without the expense of going up after it in an airplane was described by Dr. J. Patterson, of the Canadian Meteorological Service, Toronto. He has devised an apparatus that will flash back signals of temperature and pressure from an ascending small balloon as long as the observers can keep it in sight through a telescope.

Hitherto, similar apparatus has been carried up arranged to record its experiences with a pen on a slowly moving strip of paper. But to get the story it is necessary to wait until the balloon comes down again and then depend on the chance of the apparatus being found and sent back by some farmer or woodman. The new device is equipped with red and white electric lights fed by a flashlight battery. The mechanism is arranged in such a way that the order of flashing of the lights will tell the observer on the ground whether the balloon is passing from warm air to cold or *vice versa*. Similarly, another light signals by its flashings how much the barometric pressure is changing as the balloon rises.

Dr. Patterson pointed out that this device should be especially useful to meteorologists in polar regions or other unpopulated parts of the world, where the ordinary registering instruments are useless through the impossibility of getting them back again.

Gravedigging, an occupation as far removed from airplanes and balloons as can well be imagined, can also be made to yield data of value to the meteorologist, Dr. C. L. Fassig, of the U. S. Weather Bureau, told his

hearers. In making a study of how deep frost gets into the ground in winter, he had recourse to engineers and contractors, and also to those melancholy laborers who prepare for each of us his last house. The data thus gathered are expected to be of value to roadbuilders, construction firms and all whose business has to do with making holes in earth that may get frozen.

A vivid report of weather in a region where there is never any question whether the ground is frozen was made by Dr. W. C. Haines, of the U. S. Weather Bureau, who was with Byrd in Antarctica. He told tales of taking observations in forty-mile blizzards with frost so thick on the lens of his instrument that it had to be scraped off with a stick; of powdery snow driven in through minute crevices jamming the clockwork of automatic recording devices; of "freeze-proof" ink frozen solid until it was diluted with alcohol and glycerin. The lowest temperature experienced during the year in Little America was 72.4 degrees below zero Fahrenheit; the highest, 35 above; an average for the whole year, 12.7 degrees below.

In spite of all these difficulties, however, the meteorological work was carried on successfully. Observations were taken daily at the base camp and on the over-ice expeditions. Over 400 sounding balloons were released and watched with instruments that made height and drift computations possible. Some of them were seen to ascend to as much as 30,000 feet. Kites and airplanes were used for capturing recorded data from aloft. A great mass of meteorologic data, the most complete ever compiled at "the bottom of the world," came back from Antarctica with the triumphant return of the Byrd expedition.

THE LABRADOR CURRENT AND ICEBERGS

THE Labrador current is weak this spring, and brings few icebergs. The warm Gulf Stream is taking advantage of this weakness to invade northern waters more deeply than usual.

These are among the first results of the exploratory trip of the U. S. Coast Guard vessel *General Greene*, under the scientific direction of Dr. Olav Mosby, a young Norwegian oceanographer who is making a study of ice movements and their causes in the waters off Labrador and Newfoundland.

Only one berg has been sighted so far, Dr. Mosby stated in a report to *Science Service*. This was picked up in latitude 47 degrees 2 minutes north, longitude 52 degrees 39 minutes west, and followed until it grounded, in latitude 46 degrees 36 minutes north, longitude 52 degrees 53 minutes west. Its drift was very slow and irregular, evidently mainly the work of winds and tide currents, indicating great weakness of the Labrador current, the usual highway of icebergs.

Temperature reports from ships in the North Atlantic indicate unusually warm water for this time of year, and a notable extension of the Gulf Stream toward the north. Temperatures from 50 to 60 degrees Fahrenheit have been reported from the latitude of the Grand Banks. These are ten or twenty degrees higher than those of

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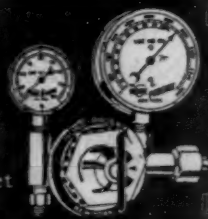
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1924, the "poorest" iceberg year so far on record, when the ocean temperature stood at about 40 degrees at the same latitude. In 1929, the "richest" iceberg year, the readings were from 40 down to 34 degrees. During 1929, 1,351 icebergs were sighted south of Newfoundland; 322 of them in April alone, as against a solitary one during the month just past.

The mildest winter on record is reported from Newfoundland. St. Johns harbor, usually frozen from late December until March, was ice-free this year, and no pack-ice drifted down from the North. Atlantic salmon were offered in the St. Johns market in January and February; these fish are not usually caught until May or June.

STUDY OF OBESITY

OVERWEIGHT is dangerous to the human body, but improper means of reducing weight may be even more so. Of the many women who in recent years have adopted ridiculous dietary measures on their own initiative, some have suffered from extreme under-nutrition or ill health, and some even have died. The so-called eighteen-day diet is deficient from every standpoint. These matters were recently discussed by Dr. Clifford J. Barborka, of the Mayo Clinic.

It has been found that 70 to 85 per cent. of persons with diabetes are or have been obese, and that 50 per cent. of persons with high blood pressure are overweight. Many of those with gallstones, abnormalities of the heart, varicose veins, excessive perspiration and eczema are fat, and the surgeon knows that overweight adds to the risk if patients must undergo operation.

However, the condition seems to run in certain families. Then there are certain physiologic causes of increase in weight. The nursing mother tends to grow heavier; so does the patient who is convalescing from an operation or a prolonged illness. Increases in flesh are frequently seen at puberty, in pregnancy and after the change of life in women.

It is an apparent paradox that certain persons get fat and that others do not on what appears to be equivalent diets. There can be no doubt that obesity is often the result of over-indulgence in food and lack of exercise, but certain persons gain weight on what appears to be a moderate intake of food, or even a restricted diet, and who take considerable exercise.

What type of obesity is troubling a given patient may require a great deal of study by a physician. If dietary restriction is deemed necessary, the highly technical plan devised by Dr. Barborka can be applied under trained supervision. It is worth while, by annual physical examination, to keep track of changes in weight, and thus to learn whether an increase means the physiologic plumpness of good health, or whether it means danger to physical well being. Even if it is nothing to worry about, that is worth knowing.

ITEMS

THE lofty peak of Indrapoera, a volcano in Sumatra, has been set aside as a nature preserve by the Dutch Government. Cultivation on its slopes runs up to an

altitude of about 5,600 feet, but above this the land has been barred to plantations and lumbering. The new preserve contains about 25,000 acres, and reaches an altitude, at the summit of the mountain, of about 11,800 feet. Elephants roam in its forests. On its summit grows an exceedingly rare species of primrose, known as *Primula imperialis*. This flower is found on the highest mountains in Java and Sumatra and on the mainland of Asia only in the Himalayas.

THE University of Illinois has obtained a permit to excavate the Indian cemetery near East St. Louis, where a contractor has reported uncovering four skeletons in good condition, and traces of other skeletons remaining in place. Excavation at the site will begin at once, according to Dr. A. R. Kelly, archeologist of the University of Illinois. The graves are on bluffs overlooking French Village near East St. Louis, Dr. Kelly said. Men who have dug and carted dirt away from the locality in the past two or three years have occasionally found human bones. How much of the cemetery remains is not known.

THE heaviest and strongest railroad rail ever built for regular service will be rolled this month, according to Elisha Lee, vice-president, and W. S. Franklin, assistant to the vice-president, of the Pennsylvania Railroad, in a report to the American Society of Civil Engineers. The new rail section weighs 152 pounds per yard as compared with the former 130 pounds and is the result of two years' intensive study by engineers of the Pennsylvania Railroad and of the United States and the Bethlehem Steel Companies. It will be rolled by the two steel companies. Although the new rail is only 22 pounds heavier than the present 130 pounds standard, it is 75 per cent. stronger. It will be used where traffic is heaviest. The rail that will be used on the greater part of the road is a second new type which is only one pound heavier than the present standard, but 22 per cent. stronger.

A SEA eagle that does not eat fish is the anomaly reported by Professor I. Aharoni, of the Hebrew University in Palestine, in a communication received by the New York office of the university. Professor Aharoni captured several specimens of this eagle on a recent zoological collecting trip to the Lake of Antioch in Syria, a body of water known from antiquity but little explored by scientists. On examining their stomach contents he found the bones of mice and birds in considerable quantity, but no traces of fish, in spite of the fact that this species is never found far from large bodies of water. Another very peculiar bird found on this trip was the Syrian darter, known locally as the oustalet. This is a waterfowl, nesting among the high reeds that cover the wide lake flats. Its nesting season is governed by the height of the lake, for it can not build until the water has got low enough for it to break down the reeds. Then it piles up a criss-cross structure of stems with their sharp ends pointing outward, forming a formidable defense against many of its enemies.

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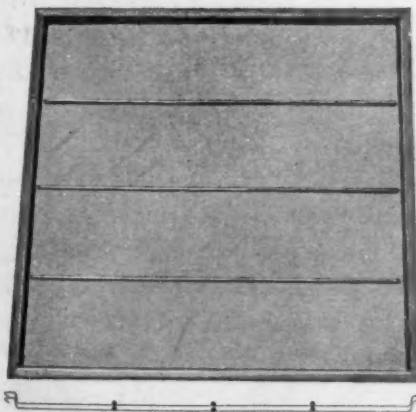
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MICHELSON'S LAST EXPERIMENT

DR. ALBERT A. MICHELSON'S last measurements of the velocity of light, interrupted by his death, will be completed. His associates, Dr. Francis G. Pease, of Mount Wilson Observatory, and Dr. Fred Pearson, who was Dr. Michelson's assistant for twenty years, will finish the experiment, still in progress, as originally planned by Dr. Michelson.

But the world's most precise determination of the speed of light had progressed sufficiently far before Dr. Michelson's death to allow him and his associates to arrive at a tentative value. "The tentative value for the velocity of light resulting from this experiment is about the same as that obtained by Dr. Michelson's experiment on Mount Wilson," Dr. Pease informed *Science Service*.

Just four days before his death, Dr. Michelson dictated from his sick bed the outline of the scientific paper which will eventually announce to the scientific world the most precise value of light's velocity, one of the most fundamental values in physics.

The mile-long tube in which the present light experiments are performed is located on Irvine Ranch, near Santa Ana, south of Pasadena. In erecting this unique laboratory Dr. Michelson had the cooperation and support of the Mount Wilson Observatory of the Carnegie Institution.

The long tube in which the tests are made cost \$50,000 and took two years to complete. Its length was accurately measured by experts of the U. S. Coast and Geodetic Survey with an accuracy of one part in a million. It is three feet in diameter and its welded construction made it possible to exhaust practically all the air within it. To exhaust the thousands of cubic feet of air in the pipe, vacuum pumps are run day and night. Only 125 cubic feet of air are left in the tube during the tests.

The Michelson tube gives science's first opportunity here on earth for measuring light's velocity in vacuo. Dr. Michelson's previous light velocity measurements were made by sending a beam of light from a distant mountain peak to a revolving mirror on Mount Wilson, where the famous Carnegie Institution observatory and world's largest telescope are located.

The 1926 experiments on light traveling twenty-two miles from Mount San Antonio to Mount Wilson gave a light velocity of 299,796 kilometers per second, or 186,290 miles per second. This is believed to be accurate to within 4 kilometers per second or about three miles per second. So precisely will the velocity of light be known when the present experiments are completed that it will be possible to use the speed of light as a measuring stick in precise surveying.

Dr. Michelson made his first experiments on the velocity of light shortly after he finished his studies at Annapolis and while he was still in the Navy.

EXPLORATION OF GREENLAND

ALTHOUGH colonized by the Norsemen before the year 1000, Greenland is still a lure to scientific explorers.

The loss of Professor Alfred Wegener, the German geologist and meteorologist, during the past winter while returning to the coast from an observational weather station established at the center of Greenland's great ice cap, is an unfortunate sacrifice to the continued scientific study of the largest of Arctic lands.

Professor Wegener was the leader of the German expedition which, in a coordinated program of research by British, Germans and Americans, undertook to locate and maintain three weather stations in that second coldest area on the face of the earth, the great ice sheet of Greenland.

He was widely known for his elaborate theory of the drift of continents which attempted to explain the distribution of land masses of the earth upon the supposition that all continents were once joined together and that they drifted apart forming the oceans as they now exist. Professor Wegener worked out this theory during the course of a previous voyage to Greenland some years ago.

The Wegener theory of the origin of continents is not generally accepted by geologists, but his weather researches to which he sacrificed his life are likely to be of great scientific value.

Augustine Courtauld, who has just been rescued from a weather observing station established by the British expedition, nearly made the supreme sacrifice for science.

Four nations have sponsored expeditions probing Greenland weather during the past winter. An American expedition from the University of Michigan has had observers at two stations, while the British have also had two parties in the field. The Norwegians have manned one weather station.

The U. S. Weather Bureau has received regular weather reports, sometimes twice daily, from five more permanently established weather stations of the Danish Government, all during the winter. The reports for some reason probably connected with radio transmission have been somewhat irregular in the past six weeks.

This intensive study of Greenland weather is expected to yield sufficient data to estimate its influence upon the weather of America and Europe. From such research may come improved methods for forecasting some of the storms that are believed to be greatly influenced by Greenland conditions.

THEORIES OF IMMUNITY TO DISEASE

STUDIES on theories of immunity or resistance to disease were reported by Dr. Arnold R. Rich, of the Johns Hopkins Medical School, at the meeting in Syracuse, New York, of the National Tuberculosis Association. Dr. Rich's work may lead to a change in the present methods of treating certain infections.

ADVENTURES IN Biophysics

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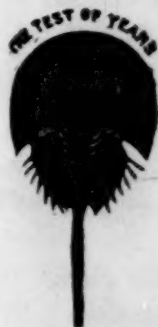
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Immunity may be acquired from vaccination with large doses of killed germs or from small doses of living germs picked up in the natural course of life. It protects the body from disease in two ways: by checking the growth of disease germs so that they die, and by preventing their spread to the rest of the body from their original point of entry.

It is a well-known fact, Dr. Rich said, that when the human body acquires active immunity to a certain disease germ, its tissues ordinarily become hypersensitive to the protein of that particular germ or bacterium. The next time the body is infected with that germ, the tissues at the point of infection are locally damaged and killed by amounts of the bacterial protein which are harmless to the normal body. Disturbing constitutional symptoms and even death may occur when amounts of the protein which would be harmless to the normal body find their way into the blood stream of the hypersensitive. The theory which Dr. Rich's studies have controverted is that this hypersensitivity to the protein of the germ is a necessary and helpful accompaniment of the development of immunity.

Dr. Rich stated that this is not the case, and described the series of experiments on which he based his opinions. He also recommended that investigators develop improved methods of freeing the body from this hypersensitivity in infections in which it acts to endanger the life of the patient.

The problem is particularly important in connection with tuberculosis. By far the greater part of the destruction of tissue which occurs in tuberculosis is directly a result of the hypersensitivity of the tissues to the protein of the tubercle bacillus. If this hypersensitivity is not necessary for the operation of immunity to tuberculosis, prevention of its damage by means of desensitization might be of great service to certain tuberculous patients.

With Dr. Allan Chesney and Dr. T. B. Turner, Dr. Rich carried out experiments which showed that acquired immunity could be established without development of hypersensitiveness.

Next he and Dr. J. Howard Brown injected the blood of hypersensitive immune animals into normal, non-immune ones. The normal animals could in this way be given immunity to the infection without being made hypersensitive.

In the final experiment, Dr. Rich, with Dr. F. B. Jennings, found that if the hypersensitiveness of immune animals was entirely abolished by suitable methods of desensitization, the animals lost none of their immunity, but were able to withstand millions of deadly doses of virulent germs.

Dr. Rich also described studies which showed how the spread of disease germs is really prevented in the immune body. Formerly it was thought that this was accomplished by the inflammation occurring as a result of the hypersensitivity. This was one reason why scientists considered hypersensitivity a necessary evil. Dr. Rich showed that such is not the case. Instead, the blood plasma and tissue fluids of the immune body act upon

the germs, changing them in such a way that they stick not only to themselves but to the cells and fibers of the tissues they have invaded. In this way they are kept at the original place of infection and are not able to spread into the body.

THE DESTRUCTION OF COYOTES

COYOTES, according to accepted tradition the most worthless and despised of all American beasts of prey, were the cause of vehement controversy at the recent meeting of the American Society of Mammalogists in Philadelphia. A special committee of the society, appointed to study problems of predatory mammal control, came in with a sweeping condemnation of the program of the U. S. Biological Survey, especially of its use of poison as a means for destroying undesired animals.

As presented by the committee's chairman, Dr. H. E. Anthony, of the American Museum of Natural History, New York, the report stated that "a crisis confronts the mammal life of our western states," called for more exhaustive study of the predatory animal problem before wholesale destruction of any species should be undertaken, and intimated that in its attack on coyotes the Biological Survey is playing favorites to a special interest, the livestock industry. Opponents of the Biological Survey's program also stated that the distribution of poison baits results in the death of many fur-bearing animals other than coyotes, and further charged that considerable supplies of poison have been placed in the hands of livestock men who make reckless use of it.

Representatives of the Biological Survey, under the leadership of Dr. Paul Redington, chief of the survey, defended themselves and their policy with vigor. There is no time to wait for long and laborious studies, they say, at least so far as the coyote is concerned. This animal is increasing rapidly, extending its territory and adapting itself to new conditions in a most disconcerting manner. Warfare against it has to be kept up and even intensified, lest it get out of control altogether.

Strong denial was also entered to the charge that the Biological Survey is primarily a "destructive agency." Of eight million dollars available, a million was spent on research and four million on conservation, leaving less than half for all kinds of biological control work. Dr. Redington also denied that the use of poison is being greatly extended, even against coyotes. On the contrary, he stated, it is being reduced. In 1930, thirteen thousand ounces of poison were used; in 1931 this has been cut to ten thousand ounces; for 1932 a further cut to eight thousand ounces is anticipated.

Traps and other means of destruction are used in preference to poison whenever practicable, Dr. Redington stated, and it is the intention of the Biological Survey to reduce the use of poison to the minimum allowed by necessity.

Further denial was entered regarding the charge that general dissatisfaction exists among fur dealers. Relatively few animals other than coyotes are killed by the poisoned baits and fur men are becoming convinced on this point. In support of the Biological Survey's con-

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FIFTH EDITION

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tention, a letter was produced from the officers of a new association of raw fur dealers, expressing satisfaction with the control work of the Biological Survey and endorsement of its principal policies.

In the end, after more than an hour of debate, the society adopted the report, and also voted to continue the committee for another year under the chairmanship of Dr. Anthony.

TRACES OF UNKNOWN EVERGLADES TRIBE

FIRST traces of the unknown prehistoric Indians who lived in the Everglades have been discovered by Mr. Matthew W. Stirling, chief of the Bureau of American Ethnology. Mr. Stirling has returned from several months of archeological exploration in Florida.

On the very edge of the Everglades, near Lake Okechobee, Mr. Stirling encountered a great plan of earthworks, elaborately laid out in embankments and mounds, and covering an area a mile square. So large and conspicuous are these earthworks, Mr. Stirling said, that it is surprising that no previous explorer has ever reported their existence or their significance. The nearest approach to anything like them are the famous Fort Ancient earthworks in Ohio, which were also made by prehistoric mound-building Indian tribes.

The most prominent feature of the Everglades site is a flat-topped rectangle of earth built 30 feet high and 250 feet long. This was apparently the focusing point of attention for whatever ceremonies were held at the site. Earthen embankments enclose a court in front of this high place. Back of it a semi-circular bank of earth was raised.

This is only a small portion of the earthworks. A curious formation consisting of a large semi-circular bank extends in front of the high place and its court. And out from the semi-circle start a number of parallel lines of banks with circular mounds at the ends. Within the great semi-circle is a platform of earth six feet high and a quarter of a mile long.

"The whole plan is laid out with remarkable precision," Mr. Stirling reported. "The parallel lines are straight as a string, and the semi-circles are so perfect that we can imagine some Indian walking around a fixed point with a string held taut, to mark the outline."

Excavations into this important site will be made next season. In his exploration visit, Mr. Stirling found potsherds on the edge of the site, showing that the inhabitants of the place were familiar with pottery. These Indians are the people who inhabited the Everglades before the Seminoles came there from farther north in comparatively late times.

Excavation of a large burial mound made of sand was another achievement of the expedition. This mound, south of Key Marco, contained 250 burials of Calusa Indians, together with their possessions. The Stone Age of prehistoric America was almost the Shell Age in this region, for the Indians had shell hoes and axes, shell cups and ornaments. Stone was scarce, though a few stone implements brought in by traders from farther north were had.

It is Mr. Stirling's view that this mound was the burial place of the Indians who left the "biggest shell heap in the United States" famous in Florida. The shell heap, representing the refuse of some very large settlement, is two miles from the burial mound.

ITEMS

AN electro-magnet weighing 14 tons, erected at Leyden by the Siemens Halske Company of Berlin, will enable the wrenching apart of atoms as never before. This marks the realization of a dream of the late Dr. H. Kammerlingh Onnes, the first man to liquefy helium, who designed the magnet. The joint action of intense magnetic force with intense cold is likely to yield new secrets about atoms, is the belief of Professor Onnes's successor, Professor W. J. Haas, who completed the work. Dr. Peter Kapitza, of the University of Cambridge, England, has recently constructed a similar magnet for use at extremely low temperatures with the same hope in mind.

PATENTS on a plastic material similar to bakelite, but made from corn cobs treated with cresylic acid, have been granted to Professor O. R. Sweeney, and have been assigned by him to Iowa State College. The material is highly resistant to chemical and electrical action and is intended primarily for insulation.

A GIANT dinosaur skeleton, seventy feet long from nose to tail-tip and twelve feet high at its humped-up hips, has just been mounted in the U. S. National Museum, and will be ready for public inspection within a few days. The huge reptile, which belongs to the genus known as *Diplodocus*, has been seven years in preparation. A corps of scientists and technicians, working under the direction of Charles W. Gilmore, have spent over 2,500 working days, the equivalent of one man's time for nine years, carving the fossil bones out of their embedding matrix of stone, finding the right places for them in the skeleton and building the carefully fitted supporting framework of wrought iron.

MINERAL oil seals and preserves for more than a year between 1,500 and 2,250 dozen eggs an hour in a new electrically driven machine for processing eggs. After the eggs are properly candled, graded and cleaned they are put on an endless, moving belt in groups of three dozen and carried through a hot bath of mineral oil which hermetically seals the shells, according to *The Electric Journal*. It is said that no other chemical or physical change occurs and that weight, color and appearance remain the same.

RURAL electric power lines can be run underground cheaper than they can be strung on poles overhead, a report to the National Electric Light Association indicates. Thus it may be possible for farming areas to enjoy underground electric distribution, which is now confined largely to better business sections and exclusive residential districts. The report urges underground conductors for single-phase, or two-wire, circuits that will not be changed to three-phase, or three-wire circuits, for a number of years. The cost of installation is said to be \$830 per mile.

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Its clear, direct style, the many pictures and diagrams, the constant application of theory to the chemistry of every-day life and especially to modern industrial processes, have always made this book interesting to students, and, consequently, unusually teachable. Revision has strengthened these features. Many new drawings, charts and photographs have been introduced. The recent startling progress in industrial chemistry has been duly described. Hydrogenation of petroleum, the newer methods of making industrial alcohols, the new use of anhydrous ammonia as a convenient source of hydrogen, helium developments, neon tubes, the latest knowledge of vitamins, the tremendous recent changes in the aluminum industry, and the newest alloys are all given up-to-the-minute treatment.

In addition, Professor Holmes has now translated the most modern theories of chemistry into terms intelligible to the elementary student—the electronic structure of the atom is cited with increasing emphasis from the very first. He has added several new chapters concerning both theory and industrial practice. They include: Chapter XXIII, *Structure of the Atom*. Radioactivity; Chapter XXVI, *Nitrogen Fixation*; Chapter XXXIII, *Cellulose and Its Esters*. Rayon; and Chapter XXXVI, *Photochemistry*. Finally, to make the book still more teachable, he has increased the number of questions, problems, and references, and added a Chapter Outline which will serve as a review for each chapter.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE AURORA BOREALIS

THE Aurora Borealis, least understood of heavenly phenomena, is not as distant from the earth as has previously been thought. Fifty to seventy-five miles from the ground is the height fixed in a report made to the Royal Society of Canada, meeting in Toronto on May 21, by Professor J. C. McLennan, Dr. Hugh Wynne-Roberts and Dr. H. J. C. Ireton, of the department of physics of the University of Toronto.

Utilizing the fact that the northern lights are visible farther south in eastern Canada than anywhere else in the northern hemisphere, the physicists photographed displays last January and February. They set up two observing stations near James Bay. One was at Blacksmith Rapids, 50 miles from Moose Factory, and the other at Coral Rapids, 30 miles farther south. The stations were connected by telephone lines and each was provided with cameras similar to those used in aerial surveying.

When the aurora was visible from both stations, the photographers focussed their cameras on areas of the sky selected by telephone, and took simultaneous pictures. The exact times were compared by telephone and checked against a master clock. Reference points in the heavens were provided by the stars, photographed on the plates at the same time. When the plates were developed and compared, the heights of shafts of light recorded at both places were calculated by the same triangulation methods used in surveying. In this case instead of a horizontal triangle, the physicists computed a vertical triangle with one side as the line joining the two observing stations.

The results show that the auroral flashes may occasionally lie 155 miles over the earth. Less than 100 miles is the usual height, however. This result agrees with similar measurements obtained in Scandinavia.

According to the Vegard hypothesis, the aurora is caused by the impinging of ultra-violet rays in the heavens on crystals of solid nitrogen. This view has long since been abandoned by physicists, however, and this report adds weight to the conclusion that some explanation other than the nitrogen hypothesis must be found for the aurora.

A GIANT DOUBLE STAR

THE greatest double star yet measured, 184 times as massive as the sun, was described before the joint meeting of the Royal Society of Canada and the Royal Astronomical Society by Dr. J. A. Pierce, astronomer at the Dominion Astrophysical Observatory at Victoria, B. C. Dr. Pierce's results were obtained with the collaboration of Dr. J. S. Plaskett, director of the observatory where he worked.

The star was first recorded at the great observatory at Mount Wilson, California, between 1920 and 1924, when preliminary spectroscopic observations were made

on it. Further investigation of the star fitted into the research program of the Victoria observatory, and the announcement is the result of spectroscopic and other photographs made with the 72-inch reflecting telescope there.

Like all double stars, the newly-measured giant consists of two great glowing spheres, instead of a single one like our sun. These constantly circle round each other, the period for the full circuit in the present case being 56 days. The two component spheres are of unequal size, one being 134 times as massive as the sun, the other only 50. The star is receding from the part of the universe we are in at the rate of nearly five miles a second.

STUDY OF YEAST CELLS

New facts on the chemical control of the life processes of the yeast cell were reported to the Royal Society of Canada, on May 21, by Dr. Helen Stantial and Dr. W. Lash Miller, of the chemistry department of the University of Toronto. They have found that acetate of soda and certain sugars will send yeast into a spore or sleeping stage.

It was Dr. Miller who two years ago surprised biological investigators by announcing at a meeting of the Royal Society the chemical formula for a substance, similar to but not identical with the vitamins, which is necessary for the growth of yeast.

Dr. Miller chose yeast cells because each microscopic yeast plant is composed of only one cell. This simplifies the investigation. Yeast cells, less than a thousandth of an inch in diameter, can be brought up in large families all alike, and they can be watched at work under the microscope. Their activity shows itself by certain chemical changes which can be found by analysis. In addition to being easy to work with as material for biological experiments, the yeast cell goes through the same changes as the cells of larger living things.

Dr. Stantial and Dr. Miller can now do some of the things by means of lifeless compounds for which elusive vitamins, extracts of glands or blood serum preparations were thought necessary. They have discovered that yeast grown with grapefruit juice would readily form "spores," or go to sleep. This spore-forming behavior is sometimes resorted to by yeasts dried-up or deprived of food material. Analysis of the juice of grapefruit showed the constituents which serve as a sleeping powder. They are now inquiring whether yeasts which have "spored" can remember processes they have been taught. This experiment is of interest in the science of heredity.

Inosite, an alcohol, the magic compound previously announced as one of the essentials for growth, may be the agent which makes the cells break in two. On a diet containing insufficient inosite, giant yeast cells, or clusters stuck together, can be produced.

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DIET AND CANCER IN MICE

DIET is not responsible for the development of cancer, it appears from experiments reported by Sir Leonard Hill to the British medical publication, *The Lancet*. Sir Leonard described his studies of mice on different diets and different beddings, which he conducted in the National Institute for Medical Research.

"Cancers have occurred indifferently in mice on all diets and on all beddings," he reported. "The significant influence has been age."

The mice were kept on five different diets as follows: an approximately natural diet for wild mice, consisting of barley, oats, wheat and fresh green food; a canteen lunch diet of cooked meat, vegetables with the usual amount of common salt, pudding and canned fruit; a canteen tea diet poor in vitamins, consisting of white bread, margarin, rock cakes and biscuits; a diet found to be the average one of Essex farm laborers, low in protein value, and the same diet of which a third had been browned by frying, in order to see whether cancer-producing products were produced in food by such burning. Some of the stocks of mice were fasted two days each week to determine whether abstinence had any effect on cancer-production.

While some of the diets had an effect on the size of the mice and their reproductive ability, there was no effect on the development of cancers. Cancers occurred spontaneously in the mice, two fifths of these tumors occurring in mice dying between the ages of one and one half and two years. Three years in a mouse corresponds to very old age in a man, Sir Leonard pointed out. About one third of the cancers occurred in mice dying between two and two and one half years.

Besides reporting his investigations of mice, Sir Leonard recounted observations on the relation of cancer and diet made by other investigators. In this connection he quoted a report of the Imperial Cancer Research Laboratory as follows: "There is no reliable evidence, experimental, statistical or clinical, which would indicate a causal correlation between cancer and the absence, or the presence, or the excess of any particular dietetic constituent. Sensational statements to the contrary are unfounded and ill-considered, and only serve to alarm the public."

INHERITANCE OF LONGEVITY

OLIVER WENDELL HOLMES'S advice to "advertise for a couple of parents both belonging to long-lived families" in order to live to a ripe old age has been tested actuarially by Dr. Raymond Pearl and his associates in the department of biology of the School of Hygiene and Public Health of the Johns Hopkins University, at Baltimore.

He finds that longevity is inherited and that there are scientific grounds for the widely prevalent idea that length of days tends to run in families. Preliminary results of his extensive studies of the inheritance of longevity are reported in the current issue of *Human Biology*, and they promise to cause geneticists to consider length of life as much an inheritable family trait

as color of eye, shape of head, form of nose or other physical features.

Thousands of family history records collected by Dr. Pearl's department were used in the investigation. Using methods by which life insurance companies determine the life tables upon which they base their rates, Dr. Pearl reports, "that the expectation of life of sons of fathers dying or living at 80 or over years of age, is greater at all ages from birth on than the expectation of life of sons of fathers dying at ages between 50 and 79 years inclusive, and is still greater than the expectation of life of sons of fathers dying under 50 years of age."

In order to establish still more soundly the conclusions, Dr. Pearl also studied the expectation of life of parents of long-lived sons and daughters in comparison with the expectation of life of parents of short-lived sons and daughters. Many other similar actuarial comparisons were made.

Parents of children dying at 50 years or over live longer by 7 to 28 per cent. than parents of children who die under 50 years of age. Grandparents whose children live to over 50 years of age themselves by the life tables have lifetimes 7 to 59 per cent. longer than the grandparents with shorter lived children.

Over half a million years of life were contained in the records upon which the studies were based. Extensive pedigrees of over 100,000 members of white Baltimore families were available for the study, each record of which was obtained by a trained field worker.

Dr. Karl Pearson, the famous English biometrist, and Alexander Graham Bell, inventor of the telephone, made studies of the inheritance of longevity which Dr. Pearl considers are based on inadequate evidence and faulty methods, and therefore do not give a correct picture of the true relations.

EUROPEAN MUSEUMS

MUSEUMS in Europe are not only unlike those in America, but the museums of one European country differ from those of another country, members of the American Association of Museums were told at their meeting in Pittsburgh, on May 22, by Mr. Laurence V. Coleman, director of the association.

"Three quarters of Germany's 1,500 museums deal with folk-lore or history. A majority of France's 1,000 museums are devoted to art or archeology. Three fifths of England's 500 museums are general in character."

Most museums in Europe are owned and supported by local or national governments. Gifts of funds are not an important source of support for such institutions abroad. Museums in foreign countries are used in education rather differently from the United States usages.

"Museums are intimate expressions of the social order," Mr. Coleman explained, in accounting for the trend which museums have been taking in various countries. "We should expect, then," he added, "to find a close relationship between museum development and the course of society. A glance at history is almost startling in its revelations of the intimacy of this bond."

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This seventh edition of the late Professor Talbot's textbook retains the conservative treatment characteristic of previous editions, but its content has been considerably changed to accord with advancing knowledge of the subject and new teaching demands. The editors have embodied in the revision the results of their long experience in using the text and have made certain important changes and additions as follows:

An improved treatment of
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In the former edition this subject was taken up briefly in Part IV, at the end of the book. Users of the new text, however, will find detailed discussions of stoichiometry distributed throughout the text, parallel with the related topics in the procedures and theoretical discussions. In this connection numerous illustrative problems are explained.

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LABORATORY PROCEDURES

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"Observe what social upheavals have done for art museums alone. The French Revolution produced the idea of museums for all the people. The industrial revolution made public institutions out of the private collections which the Romantic revolution had induced and it gave art museums an active rôle by setting them up as fortresses against invasions of the machine. The 'Financial Revolution' enabled the machine age to achieve new values, and thus it has induced museums for the first time since the Crystal Palace Exposition to look without fear upon their own day and time."

THE S-ROTOR

THE S-rotor, a new, simple and inexpensive type of windmill which, in addition to its chief duty as the world's most efficient harnesser of power from moving air, will ventilate buildings, generate power from the tides and draw smoke from stubborn chimneys, was described before the aeronautic division of the American Society of Mechanical Engineers, meeting in Baltimore, by its inventor, S. J. Savonius, of Helsingfors, Finland.

Mr. Savonius began work on the S-rotor several years ago after his interest had been aroused by the success of Anton Flettner, the well-known inventor of the rotor ship. To make an S-rotor, so named after similarity between its cross-section and the letter S, a Flettner rotor was cut in half vertically and the halves separated along the cutting plane. Thus a vertical rotor that will turn equally well regardless of the direction of the wind is made.

Although rotors of this type are more efficient than ordinary windmills, they cost no more to make. They are coming into wide use in Europe where one of the manufacturers is Anton Flettner, who is recouping some of the fortune consumed in the exploitation of his rotor.

As a ventilator, the Savonius rotor was said to be operating efficiently where ordinary cowls have failed. It develops uncommonly strong suction power. In the water the rotor operates the same way it does in the air, but since water is about 800 times as heavy as air the power generated is greater in proportion. One of its advantages as a tidal motor is that it always turns in the same direction regardless of whether the water is ebbing or flooding.

Mr. Savonius did not make exaggerated claims for his invention. He said that it is not suitable for power plants of such magnitude as those contemplated by Georges Claude in his recent experiments in Cuba, but that it is adapted to small and inexpensive plants working in a river or tidal creek and that as such it could extract a considerable amount of power for use in irrigation and for supplying light and power to farms and villages.

ITEMS

FIRE has destroyed the computing room of the Smithsonian Institution Astrophysical Observatory station on Montezuma Mountain, Chile, and as a result the study of the sun's radiation conducted by observers there will be delayed slightly. Each day on that mountain peak,

nearly 9,000 feet above sea-level, two investigators measure the radiation of the sun, and cable the results to Dr. C. G. Abbot and his associates of the Smithsonian Institution. The solar constant so determined is distributed throughout the world by radio and promises to be a fundamental inconstant of nature, of use in making long-range weather forecasts. The fire loss just reported to Washington by Clay P. Butler, director, and Walter Watson, Jr., assistant, did not affect the actual observing instruments, but the loss of charts and records will prevent computation of the daily cable for about two weeks.

OBSERVATIONS of a comet at the great distance of 588,000,000 miles, or about 6.33 times the distance of the sun from the earth, have given astronomers ground for thinking that it will be observed completely around its orbit, and that it will return to the neighborhood of the sun without ever having been out of sight. A study of the Schwassmann-Wachmann comet, discovered last winter by two German astronomers, indicates that it will probably establish this new record, according to Dr. George Van Biesbroeck, of the Yerkes Observatory. When first photographed, on December 16, it was of the sixteenth magnitude, far too faint to be visible to the naked eye. A second photograph, made on February 11, showed that it had brightened to the twelfth magnitude, which is also much below naked-eye visibility. A month later it was again of the sixteenth magnitude. It is now so far away that it will probably not become greatly fainter. Only about two years will elapse before it reaches aphelion, the point of greatest distance from the sun.

STUDIES of rubber and cellulose are reported by Professor Kurt H. Meyer and Dr. H. Mark, of the I. G. Farbenindustrie A. G. By correlating the evidence from X-ray and chemical investigations with those of microscopic form it is now possible to have a clear idea of the arrangement of the atoms. It is easy to understand how a simpler substance like sugar, for instance, is built up as there the molecular units are laid regularly side by side like the bricks in a wall. The molecules of cellulose, the tough, fibrous material of wood, cotton, linen and paper or the carbon and hydrogen atoms of rubber, however, are linked together in a network resembling a sponge where it is difficult to say where one brick leaves off and the next begins.

THE whole width of the Pacific, from Mexico to the Philippine Islands, was traversed by a drifting bottle in about a year and a half, according to a report recently made to the U. S. Hydrographic Office. The bottle, which was picked up on February 23, in latitude 11 degrees 53 minutes north, longitude 124 degrees 10 minutes east, contained a paper stating that it had been thrown overboard by Second Officer C. E. Carlsen, of the American steamer *Castle Town*, on August 11, 1929, in latitude 18 degrees 38 minutes north, longitude 124 degrees 4 minutes west. It had drifted about 7,900 miles.



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SCIENCE NEWS

Science Service, Washington, D. C.

BALLOONS AT HIGH ALTITUDES

PROFESSOR AUGUSTE PICCARD and Dr. Charles Kipfer, who have gone up to a height of over 50,000 feet, have been more fortunate as well as more successful than previous balloonists, many of whom have been martyrs to the conquest of the atmosphere.

The record balloon ascent in November, 1927, by Captain Hawthorne C. Gray, of the U. S. Army, ended fatally for him. After several previous narrow escapes, Captain Gray reached 43,000 feet but, accidentally cutting his oxygen tube, died from suffocation before reaching the ground at Sparta, Tennessee. On a previous ascent he lost consciousness only to find himself falling at about a thousand feet per minute. Throwing ballast overboard frantically he fortunately landed on some telegraph wires without harm. On another occasion he had to use a parachute to save his life.

The record for heavier-than-air machines is about the same figure. A height of 43,168 feet was reached by Lieutenant Apollo Soucek, of the U. S. Navy.

A new method for finding high altitudes and a record for two men was the outcome of a more recent and fortunate flight with an airplane, piloted by Captain St. Clair Street, of the Army Air Corps. Photographs of Dayton, Ohio, were taken from this machine by Captain Albert W. Stevens at a height of 40,000 feet.

Lightning, another hazard of high-flying balloons which depend on inflammable hydrogen instead of the helium such as used in the airship *Los Angeles*, caused the deaths of Dr. C. L. Meisinger, of the U. S. Weather Bureau, and Lieutenant J. T. Neeley, of the Army Air Service, in 1924, over central Illinois. In making a series of balloon flights to learn the behavior of storms at great heights, Dr. Meisinger and Lieutenant Neeley were finally the victims of a thunderstorm which set fire to their balloon, an accident they had feared but had luckily escaped in previous ascents. The height reached by the Piccard balloon is only half as high as the 20 miles reached by small pilot balloons carrying no persons.

There is some doubt as to whether anything of value will be added to our knowledge of cosmic rays as a result of his flight as has been claimed. In 1922 Dr. Robert A. Millikan and Dr. I. S. Bowen, of the California Institute of Technology, sent their cosmic ray electroscopes to a height of nearly ten miles, slightly higher than the reported Piccard record.

The Piccard ascension is the first balloon flight in which a sealed cabin has been used.

Experts believe that the stratosphere explored by the aluminum sphere offers the best hope for fast-flying airplanes as the resistance of the air at these heights is very small. Such a plane with an airtight cabin is actually under construction at the Junkerswerke, near Dessau, Germany. The plane is to be used for experimental work on the conditions prevailing above six miles high as far as they will affect flying.

THE AURORA IN THE LABORATORY

THE aurora borealis has been reproduced in the laboratory. Recent experiments of Dr. Joseph Kaplan, physicist of the University of California at Los Angeles, have shown that the same peculiar light emanations which glow in polar atmospheric heights can be made by electric discharge in a glass tube. This discharge is passed through extremely rarefied nitrogen. Heretofore a number of shades of light emanation, represented by specific lines of the red and green spectrum, have been observed only in the aurora. Their source has been unknown, although the influence of nitrogen has been suspected.

Dr. Kaplan exhausts a borosilicate glass tube until it retains only one millionth of its normal air content. At such a high degree of exhaustion an electric potential of 25,000 volts is barely able to force through a luminous discharge. Such evacuation of itself is not novel; but in the recent experiments the process of discharge was continued intermittently for weeks, during which much of the scanty gas content of nitrogen and oxygen disappeared and was replaced from the outside. Finally the residual gas, largely nitrogen, gave forth the ruddy aurora glow. The exhibition improves with each day of operation.

It is suspected in the Los Angeles laboratory that some chemical change, as yet unknown, has occurred on the inside walls of the tube. This change, strangely enough, makes the discharge act as though the tube were not there. This is exactly what Dr. Kaplan wishes, inasmuch as he suspects that it is the presence of the unnatural glass wall that has interfered with artificial aurora phenomena in past experiments. This would favor the present plausible theory that the aurora results from natural electric discharge at great altitudes, perhaps one hundred miles or more. At such elevations the atmospheric pressure is much like that in the experimental tube, but of course minus the glass walls.

Accepting this theory, one would credit the aurora borealis to the emanations of nitrogen molecules "excited" by electric discharge to a condition of abnormal energy. Common glass surfaces in ordinary apparatus destroy this excitation and prevent observation of the phenomena.

THE CAUSE OF THE MEXICAN BLINDNESS EPIDEMIC

A MYSTERIOUS epidemic of blindness which apparently began in the heart of Chiapas, spreading to Guatemala and parts of Oaxaca, has been traced by Mexican Government scientists under Dr. Rafael Silva, of the Department of Health, to a simuliid fly which transmits filaria organisms to those it stings. Both whites and Indians are attacked, and the disease is spreading.

The fly, two species, *Simulium ochraceum* and *Simulium mooseri*, is known as the buffalo or turkey gnat in

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the United States. The disease, onchocercosis, is characterized by tumors, generally on the head, and an irritation of the eyes which prevents the patient from looking into the light or the sun, and in serious cases ends in blindness. In some of the worst affected areas of Oaxaca nearly all the adult population is afflicted and, in the entire Mexican region where the disease occurs, it is estimated that many thousands are affected.

When an infected simuliid bites, small filaria pass through its proboscis into the blood of the victim, looking for a place to develop, forming cysts, generally in the head. Here they become mature, laying eggs which hatch immediately. The new filaria invade the entire body, and attracted by light, enter the eyes, irritating the cornea and causing lesions which in serious cases causes blindness.

A person with cysts or tumors is a dangerous carrier of the disease. In the stomach of the simuliid fly that bites him the filaria pass through a transformation similar to that of the malaria parasite in the gut of the mosquito. The filaria reaches a latent state and passes into the proboscis of the fly waiting to enter the blood of a victim.

A similar African disease, produced by the filarium *Onchocerca volvulus*, but not accompanied by blindness, is believed to be the forerunner of the American disease and to have been brought to America by negroes. The cysts are identical. The American variation in its effects is not understood, but is believed due to some racial differences.

The Mexican Health Department is preparing five brigades to go into the affected areas of tropical Mexico in 1931 to fight the spread of the disease. No chemical has yet been found that will kill the filaria, but by removing the cysts the parasites appear to be eliminated from the body in the course of fifteen months.

ACID TREATMENT OF ROCKS

Rocks that can not be told apart as they are dug out of the ground can be made to disclose their ages and geological kinships by dissolving away most of their substances with hydrochloric acid and examining what is left under a low-power microscope. This method of geological analysis by insoluble residues has been developed by H. S. McQueen, of the Missouri Bureau of Geology and Mines, working under the direction of Dr. H. A. Buehler, state geologist.

The development of the method was brought about by the presence of quantities of limestone rock from deep wells and other borings. All the samples looked pretty much alike, though it was known that they must be of very different natures and geologic ages. The masking similarity was due to the presence of the limestone matrix itself, in which there were none of the fossil casts that are the usual dating-tags which the geologist commonly uses in identifying his finds. Following hints given by earlier workers on the same problem, Mr. McQueen undertook to get rid of the featureless limy matrix by dissolving it in hydrochloric acid, so that he might concen-

trate his study on the bits of stuff buried in it that are not soluble in the acid.

The method has worked to perfection, he reports. Each type of limestone, indistinguishable to ordinary examination, yields an insoluble residue of particles that is absolutely characteristic for that particular type and unlike the residues of other types. One limestone will have fine sand particles in it, another will contain coarser sand particles of a different color, or perhaps bits of shale, chert, or tiny round pebbles known as oolites, or minute fossil shells or casts.

A peculiar type of particles, whose existence has never before been reported, was found in some of the dolomites. These are thin walls of silica that have been built up around dolomite crystals, and when the latter are dissolved out by the acid a spongy or lace-like mass which shows the cast of the dolomite remains. Since these casts have the characteristic shape of such crystals, Mr. McQueen has given them the name "dolocasts." Dolomites from different beds have yielded different types of dolocasts upon treatment with acid, and these helped in their identification.

Mr. McQueen has found his method of value in guiding various kinds of economic enterprises dependent on geological knowledge, such as mining, oil-seeking and deep drilling for water. He has also run cross-section lines in several directions through the state of Missouri, adding materially to the general geological knowledge of the region.

LIP READING BY THE PARTIALLY DEAF

THE person whose hearing begins to fail should learn lip reading without delay, as an economic policy. This was the practical advice given recently by Dr. Wendell C. Phillips, of New York City, speaking before the annual meeting of the American Federation of Organizations for the Hard of Hearing.

The thrifty ideas of the economist can be applied to the field of partial deafness, Dr. Phillips believes, and can help to cut down the waste of human happiness and human productiveness among the deafened. It is not sound economics for the physician to advise the hard of hearing person to delay learning lip reading until deafness becomes advanced.

Among the economic advantages of learning to read the lips while hearing is only partially impaired, Dr. Phillips cited the following: The person who learns to supplement his defective hearing by use of his eyes reduces the strain on his nerves and thus improves his general health; lip reading is good training in alertness and use of the eyes; beginning lip reading early, when hearing has only begun to fail, means easier learning and therefore a smaller expenditure for instruction, so far as adults are concerned; in school children, learning to read the lips as soon as a defect in hearing is recognized will reduce the cost of education. The hard of hearing child who does not learn lip reading is seriously handicapped in school, and frequently has to repeat grades.

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DOCTOR Moulton's new book begins logically with the earth, the evening constellations, and all the familiar aspects of astronomy, and extends the student's horizon slowly to the remote concepts of the science and the farthest reaches of the universe. The author's clear understanding, comprehensive knowledge, and delightful English style enable him to unfold his complex subject step by step, simply and clearly. By pointing out the essential rôle which astronomy has played in the progress of science and philosophy he clothes it with a new importance, and he humanizes it by giving due prominence to the great names in its long and honorable history. He makes an entrancing intellectual adventure out of the painstaking observations and close reasoning necessary to its comprehension and development. The certainties of the science are disclosed—and also those far-flung speculations which fascinate the thinkers of to-day.

The illustrations, numbering 213 in all, are unusual in quantity and quality. They include many beautiful photographic studies, and new star maps for unaided-eye observation.

The tables, questions, exercises, and lists of references distributed throughout the text are valuable teaching features.

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Knowledge of lip reading enables the hard of hearing person to have happier and more satisfactory social contacts, and so leads to an improved mental outlook on life.

THE SEVENTEEN YEAR "LOCUST"

No alarm need be felt over the advent of the 17-year "locust" brood of 1931, scheduled to appear in vast hordes during the last week of May in the region centering about the eastern two thirds of Ohio and comprising portions of Pennsylvania, West Virginia, one or two points in Virginia and the northeastern corner of Kentucky.

Wrongly confused with the grasshopper plague of Egypt, the 17-year "locust" is really a cicada and an almost harmless relative of the harvest fly, though it appears formidable because of the noise it makes and the great numbers in which it sometimes appears. Indeed, the crop danger is confined almost entirely to very young plants, such as nursery trees, and the total damage done, even by a record brood, is slight.

For this reason attempts to exterminate the 17-year "locust" are uncalled for, in the opinion of J. A. Hyslop, entomologist in charge of Insect Pest Survey of the Bureau of Entomology. Living for 17 years underground and hatching almost to the day, year in and year out, whether the season is warm, cold, wet or dry, the 17-year "locust" is a biological curiosity which should be preserved for the interest of future generations.

Study of these strange insects has already held the interest of scientists for about a century and they are able to forecast with a high degree of certainty the size and distribution of the brood which is due to appear by the history of the "locust" crop of 17 years ago.

This year's 17-year "locust" crop is designated as brood five in the series of 17 annual hatchings which occur in rotation. Not as large as brood 10, the brood of 1931 is, nevertheless, very numerous and well defined in the regions where it occurs. Its advent has been heralded by the appearance of numerous small holes in the ground from which the locust emerges.

Always appearing in the last week of May, the 17-year "locust" persists through June and disappears by the fourth of July. During the four or five weeks of their life above ground, the insects feed very seldom or not at all, depending on the reserves accumulated during their long underground life. Damage may be caused, however, when the females deposit their eggs in furrows cut into the green bark of young twigs. This causes a temporary defoliation of many trees, but no permanent harm in the forests. It does at times cause damage, however, in orchards and nurseries.

AIRPLANES FOR HIGH ALTITUDES

AIRPLANES flying at heights of over six miles, which can reach much higher speeds than existing machines are being constructed at the famous Junkerswerke at Dessau. Already the first airplane to be used for research in this work has been constructed with the

assistance of the German Institute for research in air communication and the scientific Notgemeinschaft.

The mysterious guns of the German Army, bombarding Paris at a distance of 75 miles, were the first practical application of the decidedly lower resistance of the "stratosphere," that tenuous layer of the atmosphere lying above a height of six miles. The chief aim of the new machine is to reach high altitudes and to find paths which can be used as regular airplane trade routes. It is not built for high speed or long flights, since it is regarded as an experimental laboratory for the study of the special conditions prevailing in the stratosphere. High speed can easily be attained at these heights. Recording rockets and balloons have been previously used to explore the stratosphere.

The airplane is a Junkers metal deep-deck, single-motored machine of wing breadth 60 feet and weight 9,000 pounds. A small compressor keeps the air pressure normal for the lungs within the cabin, which is double-walled and airtight. Control of the motor and steering is done by levers in the cabin working in airtight shafts. The motor itself is of a special type and has an airpump to supply enough air from the thin air at these heights.

On the basis of experiments with this machine a new airpump will be designed for altitudes up to ten miles. A large installation of scientific instruments forms the equipment of the machine.

ITEMS

THE epidemics of scarlet fever and measles which have visited the country have reached their peaks, it appears from reports of state health officers to the U. S. Public Health Service. For the week ended May 23, there were 20,080 cases of measles and 4,727 cases of scarlet fever. This is a drop of about a thousand cases for each disease over the previous week's totals. The measles epidemic has been general over the entire United States, while the scarlet fever outbreak appears to have occurred largely in the Atlantic and East North Central groups of states. The most cases of scarlet fever were reported from Massachusetts, New York, New Jersey, Pennsylvania, Illinois and Michigan.

A SAFETY fuel for automobiles and airplanes that is as incombustible as Diesel oil and yet as powerful and as productive of engine performance as good aviation gasoline was demonstrated at Langley Field before the sixth annual aircraft engineering research conference of the National Advisory Committee for Aeronautics. The new liquid is being tested at the Langley Memorial Aeronautical Laboratory in a special single-cylinder engine. This new fuel, produced by one of the leading oil companies, by means of the new process of hydrogenation, has such a low flash point that a lighted match can be tossed into it without starting a fire. To use the new kind of fuel it is necessary to replace the conventional carburetor with an injection pump, but the explosive mixture within the engine cylinder is fired by electrical ignition rather than by compression as in the Diesel engine.

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SCIENCE NEWS

*Science Service, Washington, D. C.*STATIONS FOR THE STUDY OF
EARTHQUAKES

THE great central valley of this continent and the West Indies region are the two areas most in need of further development of seismological stations, Captain N. H. Heck, earthquake expert of the U. S. Coast and Geodetic Survey, told his hearers at the meeting of the eastern section of the Seismological Society of America meeting at Columbia, S. C., on June 11. The parts of the country best equipped for earthquake study are the Atlantic and Pacific Coasts.

Along the Atlantic coast there is a string of stations all the way from Maine to South Carolina. In the latter state there is a brand-new station, established and operated jointly by the University of South Carolina and the U. S. Coast and Geodetic Survey. Two outstanding stations in this string are those of Fordham University, in New York, and Georgetown University, in Washington. These are equipped with the latest instruments for detecting the minute up-and-down movements of the earth caused by distant quakes, as well as the east-west and north-south movements.

This line of stations is advantageously situated for the study of earthquakes originating in the Caribbean region and on the west coast of South America. The recently modernized station of the U. S. Coast and Geodetic Survey at San Juan, Porto Rico, and the new station of the Carnegie Institution of Washington at Huancayo, Peru, serve as valuable southward extensions of this chain, particularly with reference to earthquakes that might affect the Panama Canal and the projected Nicaragua Canal. Captain Heck suggested the desirability of new equipment for the seismological station at Balboa, in the Canal Zone.

Outstanding work in the central region of this country is being done by the Jesuit Seismological Association, with headquarters at St. Louis University, and branches in Jesuit educational institutions all the way from Canisius College, Buffalo, N. Y., to Regis College, in Denver. Another prominent station is that of the University of Chicago, operated under joint arrangement with the U. S. Coast and Geodetic Survey. New instrumental set-ups have been installed at the University of Pittsburgh and Montana State College at Bozeman. More earthquake study centers are needed in the Midwest, especially in the area stretching from Minnesota to Texas.

REDUCTION OF LOSS OF LIFE IN
EARTHQUAKES

REDUCTION of loss of life in earthquake disasters to great cities, such as the destruction of San Francisco in 1906 and of Tokyo in 1923, is one of the practical goals sought by scientists. At the meeting of the eastern section of the Seismological Society of America at Columbia, S. C., Professor Alexander McAdie, of Har-

vard University, suggested lines along which work can be done to ameliorate earthquake harm.

Earthquakes can not be prevented, Professor McAdie said, but they can be predicted, and it is worth while to make the special effort required to get the necessary data.

The first step toward minimizing earthquake damage and death in regions where earthquakes can be expected is the planning of quake-resistant buildings. In the Tokyo earthquake, buildings designed by Professor Naito came through practically undamaged, in striking contrast to the general demolition of other structures. The Japanese are constantly at work on this problem, and engineers on our own west coast have also been giving the matter much attention.

But the greatest loss of life following an earthquake, even a very destructive one, is very likely to result from secondary causes, such as fire, exposure to the weather and pestilence. The greatest factor in life losses following quakes, Professor McAdie said, is congestion of population. This aggravates the action of all the other factors of destruction, and should be the thing most vigorously guarded against.

Other safety measures include sanitary regulations for the prevention of typhoid and other bacterial diseases, adequate water supply and fire protection and provision for the protection against the weather of a population suddenly rendered homeless.

RESEARCH INTO INSANITY

A PRACTICAL program for research into the causes and possible cure of the type of insanity known as dementia praecox was submitted to members of the American Medical Association meeting at Philadelphia on June 11, by Dr. Roy G. Hoskins, director of research at the Memorial Foundation for Neuro-Endocrine Research, Boston, and the Worcester State Hospital, Worcester, Mass.

Dementia praecox, or schizophrenia, as it is sometimes called, is a dire mental disorder which develops in childhood or adolescence. There are 140,000 subjects of this disorder confined in mental hospitals to-day. Each of these represents a wrecked life and a grave social maladjustment.

The disease costs the United States alone over a million dollars a day. For less than one-fifth of this daily cost, or \$200,000, a complete research unit of 120 beds can be maintained to carry out the program proposed by Dr. Hoskins.

Dr. Hoskins's plan for research is based on the theory that dementia praecox does not represent one single disorder, and that there is a physiologic basis for the disease. He considers the term dementia praecox a loose one which probably takes in numerous more or less independent disorders. "The term is, perhaps, comparable with the word fever, which may signify pneumonia, typhoid, acute arthritis, or what not."

The Scientific Book Club Selection for May

BIOLOGY IN HUMAN AFFAIRS

EDITED BY EDWARD M. EAST
Professor of Genetics, Harvard University

399 pages, 6 x 9, \$3.50

The Scientific Book Club reviewer says of

East's BIOLOGY IN HUMAN AFFAIRS:

"This composite book, like so many others of the kind that have been appearing of late, is an admirable illustration of what the scientist means when he speaks of progress. . . . The present volume deals with some of the most important applications of the newer knowledge of biology, psychology and sociology to human affairs. . . . Much of the material included here is not generally known, except to specialists, and demonstrates the ingenuity and sportsmanship of scientists in the face of difficulties . . . the reader may rest confident that the total effect of his reading will lead unerringly toward a truer appreciation of what the biological sciences have done and can do for human welfare."

Contents and Contributors

- | | |
|---|---|
| 1. Biology and Human Problems
EDWARD M. EAST, Professor of Genetics, Harvard University | 7. The Frontiers of Medicine
MORRIS FISHBEIN, Associate Professor of Clinical Medicine, Rush Medical College |
| 2. The Prospects of the Social Sciences
FRANK M. HANKINS, Professor of Sociology, Smith College | 8. The Outlook of Public Health Work
HUGH S. CUMMING, Surgeon-General, United States Public Health Service, and ARTHUR M. STIMSON, Assistant Surgeon-General, United States Public Health Service |
| 3. The Renaissance of Psychology
JOSEPH JASTROW, Lecturer, New School for Social Research | 9. Physiology of Today
ELI K. MARSHALL, JR., Professor of Physiology, Johns Hopkins University |
| 4. Educational Psychology
LEWIS M. TERMAN, Professor of Psychology, Stanford University | 10. Zoology and Human Welfare
HOWARD M. PARSHLEY, Professor of Zoology, Smith College |
| 5. Psychology in Industry
WALTER V. BINGHAM, Director, Personnel Research Federation, New York | 11. Efforts to Increase the Food Resources
DONALD F. JONES, Geneticist, Connecticut Agricultural Experiment Station |
| 6. Heredity
EDWARD M. EAST, Professor of Genetics, Harvard University | 12. Diet and Nutrition
ELMER V. MCCOLLUM, Professor of Biochemistry, Johns Hopkins University |

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Research must determine whether the condition is one single disease and if so must characterize it definitely. If it is made up of a group of separate disorders, these must be characterized and distinguished one from the other. The investigator of this problem should take into account at least 16 classes of factors which may cause the disease, with corresponding diagnostic and curative procedures. For example, possible causes are emotional conflicts or bad mental and physical habits, which may be discovered by psychological tests, personality studies or other diagnostic methods and treated by reeducation, religious counsel, or simplified environment, among other things.

On the other hand, the cause may be sought in structural defects of the body, in which case physical examination, X-ray examination, special tests and autopsies are among the methods of diagnosis, while treatment would be carried out with surgery, mechanical appliances or physical therapy.

The investigator can not hope for results from attempting to deal with the problem as a whole, according to Dr. Hoskins.

"To the practical investigator the actual problem is primarily one of strategy—of selecting an angle of approach that offers most promise of significant returns for the labor involved. He must deal individually with the workable portions of the total problem."

TO FIND JOBS FOR DEAF

A PLACEMENT center in every significant city in America, to find work for every deafened person who wants work, is the proposal made by Dr. Martin Hayes Bickham, superintendent of the Central Placement Bureau for Handicapped Workers, Chicago, speaking at the meeting in Chicago, on June 2, of the American Federation of Organizations for the Hard of Hearing.

Dr. Bickham urged the establishment of such centers not only for the sake of the deafened and other handicapped workers, but for the sake of the economic organization of the country as a whole. He stated that the way to secure a sounder economic order is to seek the economic welfare of disadvantaged workers such as these with hearing defects. As we solve one such problem after the other, we shall approximate more fully to our ideals of economic security and stability for all.

Dr. Bickham found, from countless interviews with deafened persons seeking work, that these people are laboring under a sense of resentment and injustice.

"Our ideals of personal independence and self-maintenance seem to be waning," he said. "Many of these deafened workers hunt in vain for work opportunities that will enable them to realize such ideals. They are rebuffed and driven back into themselves. No man will hire them. The result is burning resentment at the patent injustice of this industrial order."

Dr. Bickham stated that in 157 instances deafened workers had been able to secure employment through the Central Placement Bureau for Handicapped Workers. The total number of deafened persons seeking work

through the bureau between its organization late in 1929 and the close of 1930 was 235.

Workers with hearing defects do not differ from the mass of workers. When young and strong of body and up in experience and skill, the industrial system absorbs them. But in the later decades, if they drop out of the organized system they are simply lost wanderers in the midst of a highly disorganized labor market.

CUTOVER TIMBER LANDS

PUBLIC land problems are assuming a new aspect in many of the states. The pressing question used to be how to find land enough for all the applicants who wanted it; now officials are wondering what to do with the thousands of acres that are being dumped on their doorsteps *via* the tax delinquency route. Once bearing a valuable growth of virgin timber and with possibilities as fertile farm lands, these areas have been stripped of their trees and through neglect and fire robbed of their soil fertility; and now that they are squeezed empty of most of their value they are being abandoned by their exploiters to be a burden upon the community that gave them away in the first place.

Dr. Raphael Zon, director of the Lake States Forest Experiment Station of the U. S. Department of Agriculture, discusses the problem of the "new public domain" in American Forests.

"It is true that the new public domain is no longer the direct concern of the Federal Government," according to Mr. Zon. "The abandoned lands come back to the township, county or state, depending upon the prevailing state laws governing the reversion of tax-delinquent lands. In recent years, this drift of abandoned cutover and farm land into public ownership has assumed such large proportions as to become a national problem, touching the economic life of many communities.

"The physical and historic contrast between the old and the new public domain is undoubtedly great, but the social and economic aspects of the two are not unlike. The old unreserved public domain lies almost exclusively in the arid and semiarid regions of the Western States. The land now limping back into public ownership lies mostly in the humid region of the Eastern States. The old western public lands are suited for the most part only for grazing. The new public domain once supported magnificent forests. It is still admirably suited to timber production and in spots even to one or another form of agriculture.

"Legally the western public land is owned by the government; actually it is a 'no man's land,' neglected by its owner and abused by its users. The land now in the process of reversion to public ownership is also 'no man's land.' The local governments by various devices resist the transfer of the title to the public. It is not welcomed either by the state or county and is poorly protected against fire and trespass. It is not only 'no man's land' in a physical sense but often in a legal sense as well. This new public domain is also unreserved and

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unappropriated land. Like an abandoned child, it is left on the steps of the county courthouses or of the state capitols to be disposed of in the best way possible."

Abandoned farms as well as abandoned timber lands are reverting to state and county ownership, making the communities "land poor," Mr. Zon continues. This is not entirely because the lands are poor and incapable of yielding paying crops. It is at least partly due to the fact that the tax-delinquent owners of cutover timber lands have by their failure to contribute their share of the cost of community government increased the tax burden of the farmers to the point where farming no longer pays, and the farmers in their turn abandon the land and drift into the cities seeking work at wages.

Mr. Zon offers no panacea for the reverted timber-land ill. If the land-poor timber states are to become healthy again they must find means for getting the land back into its natural crop—trees—and also find uses for the inferior tree growths that have taken possession of much of the cut-over, burnt-over land. Added to this will be the use of these new public forests as recreation and vacation areas by the growing populations of our great cities.

ITEMS

PRUSSIA has just completed a celebration of the twenty-fifth anniversary of the establishment of its organized nature protection system. Reservation of natural "monuments," begun in 1906, has been carried out consistently until now there are more than 300 of such protected areas in Prussia. Some of them are very small, comprising merely a grove, or even a single tree, but others comprise many scores of square miles of heath or mountain-top. More than half of the areas have been set aside primarily for their botanical interest. Twenty-four of the "monuments" were established for the protection of birds and animals, and there are a number whose importance is mainly geological. Although the great majority of the reservations are state property, a considerable number are still private property, and there are others that are owned by associations interested in nature.

LAKE SUPERIOR is now the shrunken remainder of a larger Lake Algonquin that was left in the same area by the melting ice of the great Ice Ages, it has been proved by excavations for a dam of the Algoma District Power Company, on the Michipicoten River that empties into northeastern Lake Superior. Dr. E. S. Moore, geologist of the University of Toronto, reported to the Royal Society of Canada that his examination of this engineering work confirms the geological idea that there was a much larger prehistoric lake filling the Superior basin. As he followed the ups and downs of the geological history of this most northern of the Great Lakes, Dr. Moore found also that during the glacial era there was a smaller lake where Lake Superior now lies.

INCREASED efficiency in wind tunnels for testing model airplanes and findings important to the science of heat-

ing and ventilating have been realized through a research project conducted by the National Research Council of Canada at Ottawa. In constructing a new wind tunnel to assist in the design and construction of airplanes in Canada, J. H. Parkin, assistant director of the Division of Physics, in charge of aeronautics, took advantage of the recent discovery that tunnels with square corners, when fitted with vanes, offer less resistance to air currents than do rounded corners. By simplifying the vanes, the staff of experimenters appointed to the work constructed a tunnel which is more economical and efficient than the ordinary tunnel. The experiments were conducted by George J. Klein, K. F. Tupper and Dr. J. J. Green. While the object of the research was primarily to perfect methods for testing the effect of air currents on high speed craft, the new data on air flow has been thus seized upon by manufacturers of equipment for heating and ventilation.

THE pitch of a large bell like the Dorothea Carlile chime at Smith College is actually quite misjudged by listeners, according to Professor Arthur T. Jones, of the department of physics. The fifth partial or overtone, which is the most prominent part of the sound at the moment of striking is picked up most readily by the ear but judged to be an octave lower than it really is. The overtones are those higher components of the sound which accompany the lowest or fundamental tone of the bell. Professor George W. Alderman, of the Massachusetts State College, has collaborated with Professor Jones in measuring the vibrations from a number of church and other bells including the Harkness chime at Yale. An oscillograph, radio amplifier and moving photographic film were used in this work as well as 400 hours of the time of a computer who analyzed the curves obtained. The strike note, that is the predominating tone heard when the bell is struck, is apparently not something that is out in the air. When the bell is struck, the fifth partial is actually the most prominent part of the sound. The ear picks that up at once and, for some reason as yet unexplained, judges the pitch of the bell to be an octave lower than this fifth partial. The clapper is in contact with the bell for about one ten-thousandth of a second.

A DEVICE that takes the fire risk out of turning over in an automobile by cutting off the ignition when the car tips at a dangerous angle has been invented by V. E. Yaw, of Indianapolis. Thus the possibility of sparks showering from a broken live wire into spilled gasoline is eliminated. The safety circuit breaker is essentially a rocker arm to which is attached a two-inch lead ball free to swing like a clock pendulum. The upper end of the arm contains sliding contact brushes that rest on stationary battery and generator terminals. The device is expected to find wide application. Mr. Yaw pointed out that, according to newspaper clippings, during the six months when he was perfecting his invention 21 motorists were burned to death in automobile accidents within a radius of 50 miles of Indianapolis.

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LIGHT FROM DISTANT NEBULAE

DR. GUSTAV STROMBERG, of the Mount Wilson Observatory, reported to the Pasadena meeting of the Astronomical Society of the Pacific the results of his measurements of the velocity of light from distant nebulae that has been on its way some 70 million years.

Dr. Stromberg has been endeavoring to get a clue to one of the great mysteries of modern astronomy: Is the universe exploding? Measurements of the light from the very distant nebulae show that they are rushing away from us with terrific speeds up to 10,000 miles a second, the more distant ones moving faster.

It is possible, thought Dr. Stromberg, that the light from these great distances may not be the same as the light from less remote neighbors. To answer this he has measured its speed and found it to tally with the results of measurements on the earth.

Thus the very aged light beams have lost none of their youthful fire, still speeding along after millions of years at 186,000 miles a second. The result of his experiments checks with the requirements of the theory of relativity.

Dr. Stromberg's method depends on the fact that when one observes a star the telescope is not pointed directly at it, but makes a slight allowance for the 18-mile-a-second motion of the earth. To receive the light beam from the nebula straight along the axis of the telescope, the telescope has to be tilted through a small angle corresponding to the ratio of the velocity of the earth to the velocity of light. As the light passes along the telescope the latter is moved forward on account of the motion of the earth and hence the point where the beam of light strikes the photographic plate depends on the motion of the telescope.

If the velocity of light from a nebula differs from that from a neighboring star the nebula would appear shifted a small amount in the course of the year as the observer's own motion varied.

Dr. Stromberg's measurements at the Mount Wilson Observatory show that the velocities are alike within one tenth of one per cent. which is less than the errors involved in the experiment.

A NEW TYPE OF SEISMOGRAPH

How seismograph instruments of a new type, cheaply constructed and starting automatically to register only when an earthquake rocks the actual spot where they are standing, are being planted at various points in California to "trap" earthquakes when they happen, was told before the meeting of the Seismological Society of America by Professor R. R. Martel, of the California Institute of Technology. Professor Martel read a report from Captain N. H. Heck, of the U. S. Coast and Geodetic Survey, who has immediate charge of the work.

Although earthquakes have engaged the attention of scientific men for many years and delicate instruments

have been devised to detect them at a distance and tell how far away and how violent they are, strangely enough there has not been until the present time any instrument that could make a record of an earthquake occurring in the immediate neighborhood. They are so delicately built that a strong earthquake directly under them would wreck them. The new instruments are more ruggedly built, record only relatively large earth movements near by, and turn themselves on automatically when a quake begins.

The distribution of these instruments has been undertaken by the Federal Government largely as a practical aid to engineers and architects in designing and placing buildings so as to avoid earthquake damage as far as possible. California was not chosen as the first area to be investigated by means of the new instruments because it is the most probable scene of great earthquakes. Violent quakes have visited other parts of the continent, such as the Midwest, the Southeast and the sea-bottom off the northeastern coast. But California is a satisfactorily active seismic region, and if observers wait with patience they are likely to get the data they are looking for. Moreover, California people are more interested in earthquakes and are more ready to give the necessary local support to the research program.

THE CLIMATE OF DEATH VALLEY

THE climate of Death Valley was described in detail before the meeting of the American Meteorological Society by Ernest E. Eklund, of the San Francisco office of the U. S. Weather Bureau. Since 1911 there has been an observatory at Greenland Ranch, better known as Furnace Creek Ranch, 178 feet below sea-level and 98 feet above the lowest part of the valley.

On July 10, 1913, a maximum temperature of 134 degrees Fahrenheit was recorded at Greenland Ranch and was accepted as the highest natural-air shade temperature that had ever been recorded anywhere under approved conditions of equipment and exposure. This record was exceeded by a temperature of 136 degrees recorded at Azizia, Tripoli, in 1922. Extreme maximum temperatures of 120 degrees or higher have occurred at Greenland Ranch in every month from May to September, inclusive, and of 100 degrees in every month from March to October, inclusive. In July and August, 1917, maximum temperatures of 120 degrees were recorded on 43 consecutive days.

Though high temperatures occur in summer, freezing weather occurs frequently in winter. Temperatures of 32 degrees or lower have been recorded from October to March, inclusive, and in December, January and February, 1928-29, there were 72 consecutive days on which the temperature fell to the freezing point. An extreme minimum temperature of 15 degrees has occurred.

The nights are comfortably cool from October to April, inclusive, but in summer minimum temperatures

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of 90 degrees or higher are not unusual and minimum temperatures of 100 degrees are not unknown. The hottest month is July with the mean temperature of 102 degrees and the coolest is January with a mean temperature of 51.4 degrees. The mean daily range in temperature is about 30 degrees, but daily ranges of 50 degrees or more have occurred in practically all months.

The average annual precipitation is only 1.38 inches, and sometimes a whole year is rainless. In the period from December, 1928, to February, 1930, there were 401 consecutive days on which no measurable precipitation occurred. There are on an average only seven rainy days a year. A daily rainfall of one inch or more in 24 hours has been recorded at Greenland Ranch only four times in twenty years, and the heaviest monthly rainfall ever recorded was 1.9 inches in February, 1913.

Heavy precipitation occurs in the mountains on each side of Death Valley, generally as the result of thunderstorms, although thunderstorms are infrequent within the valley. Eighty per cent. of the days are clear. Relative humidity is often very low and high winds, sometimes accompanied by sand-storms, are not infrequent.

EVAPORATION IN PLANTS

WIRES of water running through plants from root-tips to leaf-surfaces, lifting the endless supply necessary to replace the constant losses due to evaporation. This is the picture of the internal sap transportation systems of plants most commonly accepted by students of plant life, according to Dr. E. D. Woodhouse, of Stanford University, speaking before the Botanical Society of America at its meeting in Pasadena. Water is not weak when it is confined in very narrow columns such as the sap vessels of plants; it is as strong as fine wire then, so that the water supply of a plant can literally pull itself upstairs.

But sometimes the tension becomes too great and the water wire breaks. Then the slender sap vessel becomes filled with air, and if this happens in too many of the vessels there is nothing left for the plant to do but wilt and die.

Here is where an emergency repair system, automatic in the plants, may step in, Mr. Woodhouse thinks. He suggested the possibility that "metabolic water," produced in the process of food use by the plant itself, may be introduced into these air-plugged vessels, refilling them with liquid and patching the broken ends of the column together again.

Mr. Woodhouse also offered a theory to explain the occurrence of water traveling upward in rings. Frequently, he said, the woody water-conducting tissue of trees will contain layers of water-filled vessels alternating with layers of empty ones. He suggested that the plant tends to pull its water up through the larger vessels, which offer less friction to oppose its passage. But these larger vessels also make it easier for the water wires to be broken, for their strength is greatest when they are thinnest. So that in times of drought the rings of big tubes will be empty while the finer ones will still contain unbroken columns of water.

INFANTILE PARALYSIS

INFANTILE paralysis which attacks children and young adults, leaving them crippled with wasted and paralyzed limbs, can not be controlled by ordinary methods found successful in controlling other communicable diseases, according to Dr. W. Lloyd Aycock, associate professor of preventive medicine at the Harvard University Medical School.

Dr. Aycock's paper was given at a special symposium on immunity at the Philadelphia meeting of the American Medical Association. At this session were discussed the various ways in which individuals develop the ability to withstand exposure to disease without becoming ill. Immunity to the germ diseases and also to the poison-ivy, hay-fever type of disease which is due to hypersensitiveness to specific protein substances, was discussed. Whether or not a person develops infantile paralysis when exposed to the disease for the first time depends on certain factors of individual susceptibility. This is true for other diseases which, like infantile paralysis, are caused by viruses; such as smallpox, rabies, chickenpox, yellow fever and some animal diseases like foot-and-mouth disease.

Dr. Aycock said his investigations suggested that persons who are susceptible to infantile paralysis may be persons whose physiological mechanism for adapting to changes in climate and season is faulty. The body changes normally with the seasons and in response to changes in climate; some people, however, have a faulty bodily adjustment in this regard and fail to make these changes. The seasonal and geographical occurrence of infantile paralysis suggests that these people whose response to climatic changes is not normal are susceptible to the disease. Dr. Aycock is investigating this phase of the problem by studying the physiology of infantile paralysis patients and by studying the effect of artificially induced physiologic changes on the susceptibility of certain animals to the disease. The virus of infantile paralysis is rather wide-spread, yet relatively few persons develop the disease in spite of the fact that they must come in contact with the virus frequently. Some scientists believe immunity to the disease develops spontaneously as people grow older. Dr. Aycock disagrees with this view. He believes that there is wide-spread immunity to the disease. The development of this immunity in adults who have not had the disease is associated with the presence of the disease virus.

ELECTROSURGERY AND CANCER

"THE value of controllable heat as a substitute for the surgeon's scalpel can not easily be overestimated," in the opinion of Dr. A. C. Scott, of Temple, Texas, who took part in a discussion of electrosurgical treatment of cancer at the closing session of the American Medical Association.

The combination of surgery and heat are the two most potent agents known for the eradication of disease, he said. While the radio knife and electrosurgery and diathermy are modern developments, Dr. Scott reminded his hearers that the use of heat in surgery was prac-

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ticed by the Chinese in a crude way four thousand years ago.

The value of electrosurgery is that it cuts down the chance of recurrence of cancer. Cancer cells become sterile at a temperature of 120 degrees Fahrenheit. If one cancer cell, or perhaps a group of a dozen cancer cells, is left behind by the knife in the ordinary operation, it might cause a recurrence. But disease can not be spread with a hot scalpel, he said. The chief value of electrosurgery is therefore its heat. Dr. Scott prefers the loop cautery knife to the radio knife because with the loop the electric current is confined to the knife. With the radio knife the current passes into the body from the knife and there is no control over it. Some tissues are better conductors of electricity than others.

BLOOD VOLUME MEASUREMENTS AND THE HEART

THE finding of a method of determining the volume of the circulating blood in man was stated by Professor Yandell Henderson, of Yale University, to be a needed step in the treatment of diseases of the heart and circulatory system, the leading causes of death to-day. Professor Henderson spoke before the American Medical Association.

"Such measurements would probably be as significant and instructive regarding conditions of health and disease as are our present determinations of arterial (blood) pressure and the electrocardiogram," he said. The measure of the volume of the circulation will unlock many secrets. Investigators are now working on this problem and a method of such measurement will be found. When it is, physicians will be able to determine the relative efficiency of the circulation in health and in heart and other diseases.

Professor Henderson described the circulation as a balance of three factors, like a tripod. One leg of this tripod is the heart pumping the blood onward; the second leg is the vasomotor nervous system which determines the resistance and pressure in the arteries. The third and chief leg, according to Professor Henderson, is the mechanism which pushes the blood back through the veins to the right side of the heart. If any one of these legs fails, the tripod, or circulation, collapses.

ITEMS

THE mechanism by which a nerve impulse can be converted into a chemical stimulus was indicated in studies reported by Professor Walter B. Cannon, of the Harvard Medical School, to the Association for the Study of Internal Secretion meeting at Philadelphia. Professor Cannon described his newly discovered hormone, sympathin, which is found very generally in smooth muscle tissue. It is probably the same as adrenalin, the stimulating secretion of part of the adrenal glands. The action of the two substances is apparently very similar. The discovery of sympathin is expected to have great practical importance. Secretion of sympathin from a muscle cell upon stimulation by a nervous impulse may be the way in which the nerve impulse can cause activity of tissues.

REMARKABLE results from high frequency electric currents in the treatment of the hopeless condition known as multiple sclerosis, or creeping paralysis, were described by Dr. William H. Schmidt, of Jefferson Medical College, at the Philadelphia meeting of the American Physical Therapy Association. Dr. Schmidt and his associate, Dr. Benjamin Weiss, of Jefferson Medical College, said that they could not call their method a cure for creeping paralysis, but that they are hopeful. Every case treated has improved and some have recovered completely. This disabling disease, for which no cure has yet been found, is characterized by remissions of symptoms, and Dr. Schmidt said that they could not be sure whether their patients had really recovered or were only having natural remissions. An encouraging feature is that the improvement has continued after the treatment has been stopped. The treatment, which is the same that has been successful in treating cases of paresis, produces a high fever in the patient. The theory is that this fever stimulates the natural defensive mechanism of the body to overcome the disease.

THE great nebula in the constellation of Orion is three times farther away than was formerly supposed, according to announcement made by Dr. Robert J. Trumpler, of the Lick Observatory, Mount Hamilton, California. He reported his measurements to the meeting at Pasadena of the Astronomical Society of the Pacific. Three different methods lead to the conclusion that this brilliant nebula is distant from the earth some 1,800 light-years, a light-year being the distance traveled in a year by a beam of light which covers 186,000 miles a second. Knowing the distance it is easy to calculate the size of the nebula. It is so big that light takes 26 years to cross it. Compared with other diffuse nebulae of the Milky Way, however, the Orion nebula ranks among the smaller. Although the matter of the nebula is highly rarefied it has an appreciable effect on the light passing through it, rendering it slightly reddish. The stars in the midst of the nebula are found to be somewhat more reddish than astronomers expected.

AN instrument that will measure the force of an earthquake that shakes it was described by Professor J. A. Anderson, of the Mount Wilson Observatory, before the meeting of the Seismological Society of America. It consists essentially of a pendulum free to swing in a given plane, but normally resisting against a stop. It can be adjusted to indicate a given force of movement by the angle of its swing. When an earthquake strikes it, the pendulum swings away from its stop. This opens an electric circuit and causes a semaphore on top of the instrument to drop. It is planned to use seven such pendulums on each installation, each set to indicate a different earthquake force. Then the operator, looking at the set-up after a quake, can tell by the number of semaphores which have dropped how severe the earthquake was. Then, simply by resetting the semaphores, he leaves the instrument ready to register the force of the next earthquake.

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SCIENCE NEWS

Science Service, Washington, D. C.

PAPERS PRESENTED AT THE PASADENA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE universal truth of one of the greatest laws of all physics, the second law of thermodynamics which requires a dying universe, was seriously questioned by Professor Richard Tolman, of the California Institute of Technology, in a paper read before the American Association for the Advancement of Science. This law, invulnerable since it was formulated by the great physicists of the last century, Clausius and Kelvin, leaves no escape from the conclusion that the universe must eventually cool down and all its motions slow up until a meaningless inactivity pervades everything. Professor Tolman by a detailed analysis has reached his conclusions by incorporating the principles of the relativity theory in classical thermodynamics. His theory is made all the more acceptable by the fact that his reasoning gives an explanation for one of the greatest of modern astronomical mysteries: The fact that the universe is apparently bursting apart at a tremendous rate. Professor Tolman begins by setting up a hypothetical simplified universe of his own, whose behavior he can study with some certainty. He finds that in it an observer provided with a rigid meter stick for making measurements would make certain deductions about that part of the phantom universe in which he found himself, but these would be quite wrong for the universe as a whole. Professor Tolman's universe is a very simple one, filled evenly with a mixture of gas and radiation—something very different from the universe as astronomers know it and yet useful for certain scientific purposes. The hypothetical observer would conclude that the "entropy" or mixed-upness of his universe was increasing and yet the entropy of the universe would actually be constant, taken as a whole. He would also find that matter in this region was being annihilated . . . that the energy and temperature of the region was dropping, and that radiation was flowing out of the region into surrounding space, which would thus appear to be at a lower temperature than the material in his own vicinity. It is from just these facts that pessimistic conclusions as to the fate of our world are drawn. However, from the standpoint of the relativistic thermodynamics invented by Professor Tolman, all the processes in such a hypothetical system would be taking place reversibly without increase in entropy, and no final dissipation of energy would occur within it. Such a universe would continuously expand by the transformation of matter into radiation. As a matter of fact our own universe appears to be doing just this. The distant nebulae are rushing away from us at tremendous speeds and the real universe is constantly expanding.

WHAT the universe actually consists of so far as the largest of telescopes can determine was told by Dr.

Edwin Hubble, of Mount Wilson Observatory. He reported that the universe is much the same wherever his telescope is pointed. There is no evidence that the great systems of stars and star stuff known as nebulae become any fewer at the very limits of observable space, a distance so great that light traveling 186,000 miles per second requires two hundred and fifty million years to reach our telescopes. When we look at the starry night sky we see principally the stars of the nebula in which our sun is one of millions of stars. Dr. Hubble explained that there are thirty million nebulae within reach of the Mount Wilson 100-inch telescope, each about a million times as bright as the sun, scattered about at intervals of about a million five-hundred thousand light years. It is such immensities of space and matter that Professor Tolman's new view of the universe perpetuates forever.

THE production of X-rays as penetrating as cosmic rays, with voltages of eighteen million, was forecast in a report made by Drs. F. Lange and A. Brasch, of the University of Berlin, which was read by Dr. Alexander Goetz, of the California Institute of Technology. Working in a small valley between two mountain peaks in northern Italy, a place where thunderstorms occur frequently in summer and early autumn, Drs. Lange and Brasch emulated Benjamin Franklin by snatching electrical energy from the skies. With their gathering system, suspended from heavily insulated wires strung across the valley, they obtained discharges of electricity which sparked twenty-five feet and measured eighteen million volts. Assured by these experiments on Monte Generoso that nature would provide the high tension electrical discharges for their experiments, Drs. Lange and Brasch returned to their laboratories at the University of Berlin to construct a new type X-ray tube, which would withstand such powerful discharges. They succeeded in building a tube of alternate rings of rubber and metal which has been tested at three million volts, continuing for an interval of a millionth of a second. These three-million-volt X-rays are the most powerful yet produced, exceeding any so far produced in America. Electrons are so speeded in this tube that they drill holes an inch deep in a brass plate at the bottom of the tube, each electron boring its own hole. The new X-ray tube, made of rubber and metal instead of glass, is less than a dozen feet long, despite the high voltage it withstands. It is estimated that an ordinary X-ray tube to withstand such voltages would need to be half a mile long, and therefore could not be constructed. When a tube now building has impressed upon it the high potentials of the natural electrical discharges there will be produced gamma rays equivalent to a hundred thousand grams of radium, which is at least a thousand times as much radium as there is now available for medical or industrial use in the world. When this experiment is performed, the super-X-rays obtained will equal the cosmic

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rays in penetration and the experiments projected should settle the question of the nature of the cosmic rays. X-rays produced with three million volts in the Berlin laboratories have already penetrated a tower of lead a yard thick.

At two great electrical laboratories in America, the California Institute of Technology, Pasadena, and the General Electric Company, Schenectady, million-volt X-ray tubes will soon be available for therapeutic use. Dr. C. C. Lauritsen, of the California Institute of Technology, estimated that the 550,000-volt two-kilowatt X-ray tube now temporarily diverted from physical research to experimental treatment of cancer cases is equivalent to at least a hundred grams of radium, which if they could be obtained would be worth six million dollars. In a new radiation laboratory Dr. Lauritsen and his associates are now building an X-ray tube to operate at a million volts. This will produce hard, penetrating rays that all the radium in the world could not produce, and the physicians working with the physicists will be able to direct the output of this most powerful tube at a single case of cancer if research during the next few years shows that to be desirable.

To the meeting Dr. W. D. Coolidge, of the General Electric Company, brought news of a new cascaded X-ray tube which will need 900,000 volts and will be used for cancer treatment at the Memorial Hospital in New York. Since the modern form of X-ray tube was invented by Dr. Coolidge and named after him, this is his latest and most advanced contribution to the production of high-energy electrical radiations.

SUCCESS in producing positive electrical particles that speed with million-volt velocities, although only forty thousand volts were used in generating them, was reported by Dr. E. C. Lawrence, of the University of California. He put the particles in a sort of merry-go-round electrical field in which they are given shoves periodically until they travel at enormous rates. Dr. Lawrence hopes to explore the nucleus with the high-speed particles.

Dr. M. A. TUVE told how he and his associates of the Carnegie Institution of Washington had produced artificially by a combination of high-voltage Tesla coils and vacuum tubes beta and gamma rays of energies equivalent to those emitted by radium. He also described a method that promises to allow him to work with voltages of ten million and perhaps more in the future.

DIAGRAMS of the structure of the atomic nucleus were shown by Professor Wendell M. Latimer, of the University of California, to illustrate a new theory of the way in which the central portion of the atom is put together. This is the ultimate and final step in determining just what is the structure of the material things about us. Beneath the seemingly solid surfaces of metals and other substances with which we have daily contact, a multitude of regularly arranged crystals have been found—row on row of them, each made up of molecules, which in turn

were shown to be definite arrangements of atoms. X-rays have aided greatly in this exploration of sub-microscopic crystal worlds. The atom was shown to be fashioned as a very heavy nucleus surrounded by very light particles or waves known as electrons. Professor Latimer has assumed the task of discovering the architecture of that internal citadel of the atom. Previous investigators have pictured the nucleus of the atom in terms of the number of protons, or hearts of hydrogen atoms, and electrons that are present. In iron, for instance, the nucleus was known to consist of 56 of the protons, as the hydrogen nuclei are called, and 30 electrons or units of electricity. The radio-active disintegration of elements like radium gave a clue to how the protons and electrons were arranged in the nucleus. Disintegrating matter gives off both unattached electrons in pairs and bundles of four protons and two electrons known as alpha particles. These particular bundles known as alpha particles are known to be also the atomic hearts of helium, the inert gas that is used to inflate American airships. Other research has shown that these protons and electrons are spinning, and opposite spins play an important part in keeping the nucleus together. Professor Latimer first arranged alpha particles in a tetrahedral pattern, that is, at the corners of a triangular pyramid. Then he assumed that each of these alpha particles is itself a tiny tetrahedron of four protons with a pair of electrons spinning at its center. This Professor Latimer presented as the best picture that can now be drawn of the ultimate in the structure of matter.

PROFESSOR R. H. FOWLER, of the University of Cambridge, pointed out that exploration of the state of the atomic nucleus was progressing steadily and that the energy laws of the heart of the atom are being discovered to be very similar to those that Professor Niels Bohr found to apply to the atom as a whole. Just as the atoms have definite energy states in which they respond much as a violin string will vibrate to a definite sound vibration, so the nucleus has definite levels of energy within it that can be probed by physicists. Portions of the nucleus can not be knocked out in the same way that electrons can be removed from atoms by bombardment, but the physicists can watch alpha particles come out of their own accord during natural disintegration. These alpha particles are the hearts of helium atoms and with protons and electrons as somewhat trivial additions they form the nuclei of all atoms. The energy changes that occur when alpha particles and protons come out of the atom's nucleus are giving a number of investigators all over the world clearer pictures of the constitution of the nucleus.

How the formation of chemical compounds is being explained mathematically by the new theories of physics was the subject of a symposium in which Dr. W. Heitler, of the University of Göttingen; Dr. Linus Pauling, of the California Institute of Technology, and Dr. J. C. Slater, of the Massachusetts Institute of Technology, took part. Before the invention of the new quantum

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theory, chemists had been unable to understand the formation of a great class of chemical compounds, those in which there is no direct electrical attraction. Ways have now been found of explaining these and many other chemical facts in strict mathematical terms. The new mathematical theory confirms completely the idea of Professor G. N. Lewis, of the University of California, that the non-polar type of linkage between atoms consist of two electrons paired. Only atoms in which there is an unmated electron can form compounds of this sort. Further, said Dr. Heitler, the quantum theory shows that the electron possesses quite a remarkable property, its spin. The electron has an axis which can not assume all directions in space. For two adjacent electrons the axes must either be parallel or antiparallel. If the spins, and therefore axes, are in opposite directions there is an attractive force between the molecules. This is the chemical force. Dr. Pauling was able to explain why some atoms combine and others not. The new theories will also explain the strength of chemical attractions, magnetic properties and the angles made by the atoms in compounds.

WAVES of electrons will soon make possible a clearer picture of the internal structure of crystals than ever before, according to Dr. C. J. Davisson, of the Bell Telephone Laboratories, New York, speaking before a joint meeting of the association and the American Physical Society. Very short wave-lengths are available in electron waves and this results in greater power to photograph the fine crystal structure of matter. Just as shortening the wave-length of light used in illuminating a microscope allows smaller objects to be seen, use of electrons made visible by their effects on photographic plates allows physicists to study more minute structure in crystalline matter. The electron waves are diffracted by crystals and give rise to diffraction patterns which are quite similar to those produced by X-rays. X-ray studies have given much information on matter's structure in the past decade. The scattering power of atoms is about a million times greater for electron waves than for X-rays. The electron waves will therefore give information chiefly regarding the structure of surfaces of crystals, whereas the X-rays give information about the structure of the bodies of crystals. He also expects that the electron waves will allow the study of layers of gas attached to the surfaces of metal crystals.

DR. P. W. BRIDGMAN, of Harvard University, discussed metal crystals and explained that much more is known about simple common salt crystals than about simple metal crystals.

DR. FRITZ ZWICKY, of the California Institute of Technology, described newly discovered secondary structure of crystals which physicists expect will aid them to a better understanding of how matter is put together.

ASTRONOMERS are not quite certain of the size of the planet Pluto which was discovered last year. Dr. E. C.

Bower, of the University of California, reported a study of gravitational pulls between Pluto and the other members of the solar system which unfortunately does not give conclusive results. The most probable result is that Pluto has seven tenths of the mass of the earth. Dr. Bower explained that an observation of the planet's disc in the hundred-inch telescope at Mount Wilson probably offers the best chance of determining its size. Since with poor seeing conditions at Mount Wilson no disc could be seen, Dr. Bower believes the outermost planet of the sun's family can not be larger than eight tenths the size of the earth. If under the best conditions for astronomical observations Pluto does not appear to be more than a mere point of light it can not be heavier than a tenth of the earth's mass.

JUST a mere fifty miles above our heads the temperature is between a thousand and two thousand degrees Fahrenheit, according to a new theory of the earth's atmosphere presented by Professor B. Guthenberg, of the California Institute of Technology. According to this theory the atmosphere is practically the same in composition throughout and not exclusively helium in some high layers, as other physicists have concluded. Although the temperatures are high in the heights of the stratosphere, the air is very diffuse and thin. Only a rocket could actually penetrate the atmospheric heights to bring back evidence of what actually exists there.

THUNDERSTORMS that come suddenly in the night are about the most troublesome feature in western aviation, and the hardest to guard against, Vincent E. Jakl, meteorologist of the Omaha municipal airport, told the American Meteorological Society at its meeting at Pasadena. It is exceedingly difficult to predict the time or place of a thunderstorm, he said, and while aviators can usually see such storms in the daytime and fly around them, it is not always possible to see them at night in sufficient time to avoid them. Other weather changes are predicted with considerable success, from maps of the region prepared at three-hour intervals and from the larger maps prepared twice each day. Aviators flying over the region with which he is especially concerned, reaching from Chicago to Cheyenne, have fewer weather troubles in the western half of the area, because it is considerably drier than the eastern half. As a possible improvement in airway forecasting, he suggested that special stations be established on either side of the air lanes, in addition to the present chains that lie directly along the lines of flight.

FOUR active substances, probably hormones, have been isolated from the placenta, part of the female reproductive organs, Dr. J. B. Collip, of McGill University and one of the Toronto group that gave insulin to the world, reported also to the Association for the Study of Internal Secretion. These substances act as sexual stimulants in both males and females. One of them is valuable in treating disturbances of the reproductive cycle in females. It is the first preparation of this type which is effective when given by mouth.

SCIENCE

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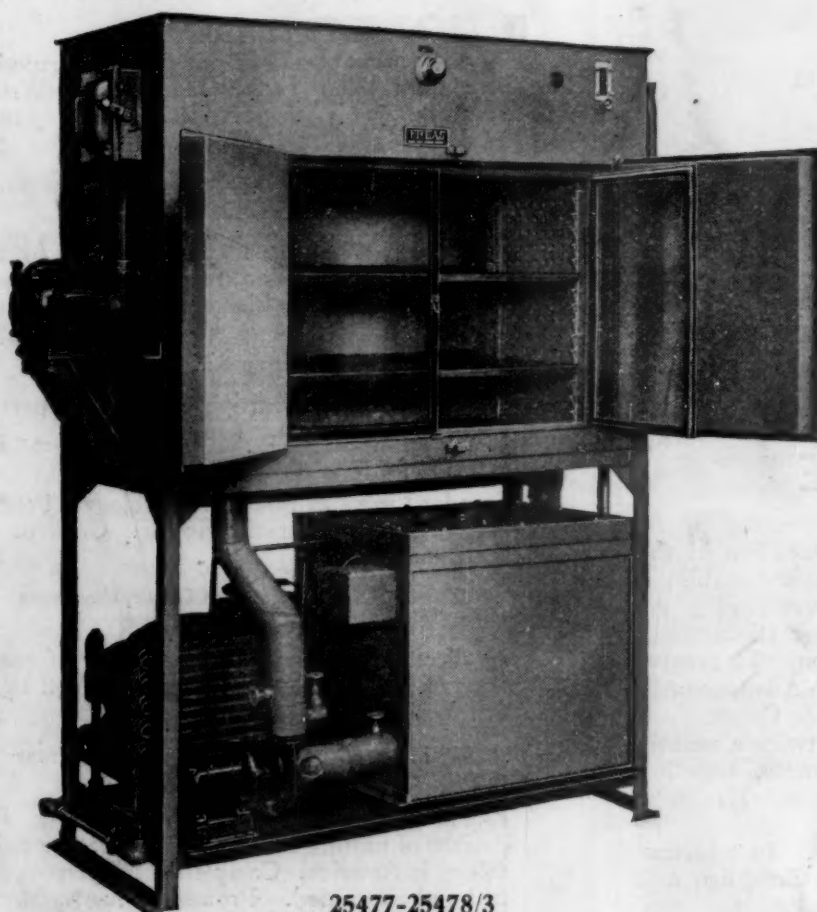
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Either of the two standard sizes here listed can be furnished, or special sizes can be readily made to order. We shall be pleased to forward any desired information concerning these low-temperature incubators—or other Freas apparatus in which you may be interested.

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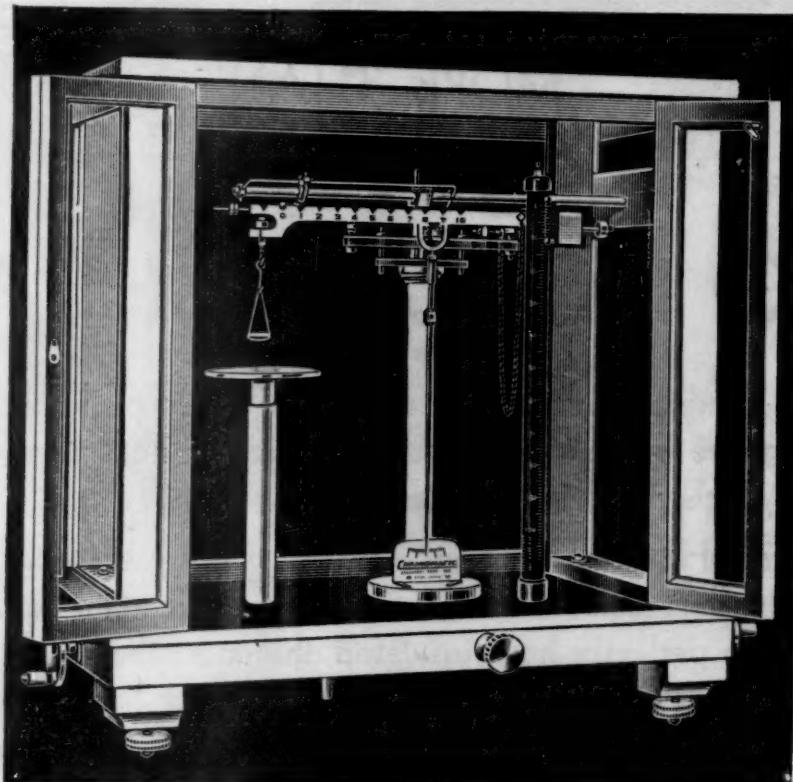
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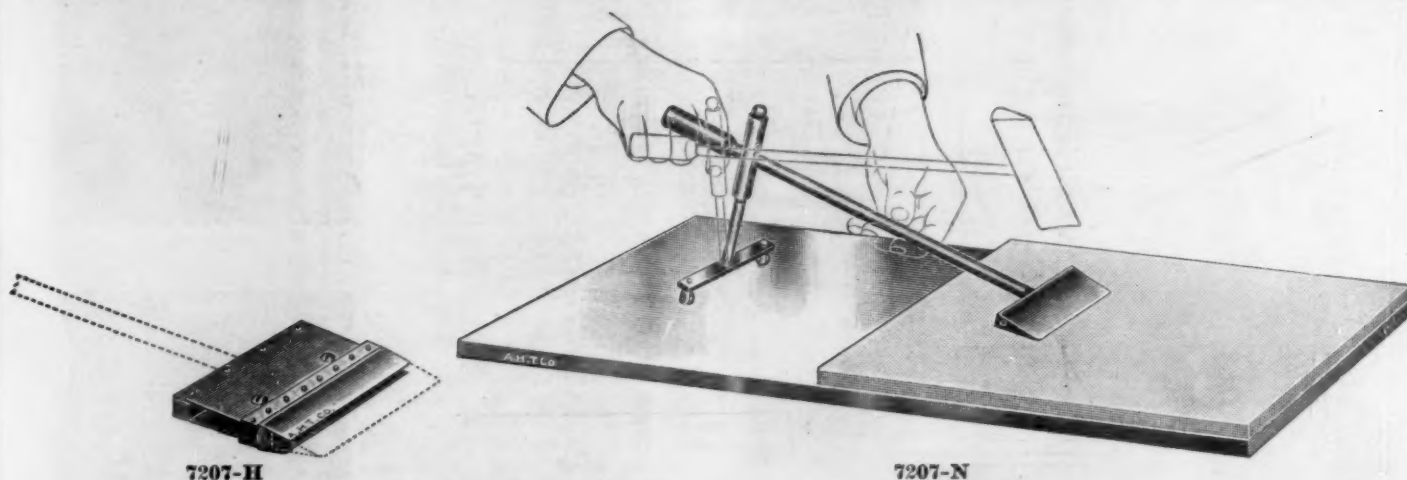
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Where the number of knives to be conditioned does not justify the purchase of either of the Fanz automatic machines, the Hand Sharpener is recommended. It provides the advantages of the glass plate—abrasive method, but with a much greater expenditure of time and personal attention for sharpening each knife than is required with the Fanz Automatic Sharpeners.

The Hand Sharpener consists of a steel rod for screwing directly into the threaded hole in the back of No. 7182-A Schmid knives and a clamp for use on knives not provided with screw hole in the back. The knife, or knife clamp, is then fixed at the chosen angle in the upright support with two steel castors, which is moved by hand on the polished glass base plate. After each stroke, the knife is lifted and reversed as indicated in the illustration. *The use of a honing guide or back is entirely obviated* and the necessary skill—much less than that required for stone honing—is quickly acquired if directions are followed.

The abrasives used are the same as those recommended for the Fanz automatic machines and the upper glass or grinding plate, on which the abrasive solution is spread, is furnished with plane matte surface on one side and polished on the other.

		Code Word
7207-G.	Microtome Knife Sharpener, Schmid Hand Model, as above described, for direct attachment to threaded hole in back of No. 7182-A Schmid knives. Sharpener only, without clamp for knives of other make, glass plates or abrasive material.....	14.00 Khawi
7207-H.	Knife Clamp, only, for use with above for knives not provided with threaded hole in back. Takes knives up to 12 mm thickness of back	8.00 Khayo
7207-K.	Glass Base Plate, only, with surface polished and edges ground, 28 inches long × 14 inches wide × ½ inch thick	7.50 Kheax
7207-L.	Glass Grinding Plate, only, with plane matte surface on one side and polished on the other, 14 inches long × 14 inches wide × ½ inch thick	3.75 Khect
7207-N.	Microtome Knife Sharpening Outfit, Schmid Hand Model. A complete outfit for use with No. 7182-A Schmid knives with threaded hole in back, consisting of No. 7207-G Sharpener, No. 7207-K Glass Base Plate, No. 7207-L Glass Grinding Plate, and outfit of abrasives and accessories as supplied with the Fanz Automatic Sharpeners. With detailed directions for use.....	30.00 Khedr
7207-P.	Ditto, but with the addition of No. 7207-H Knife Clamp for use with knives not provided with threaded hole in back	38.00 Khefn

See overleaf for description of A. H. T. Co. Specification Schmid Microtome Knives

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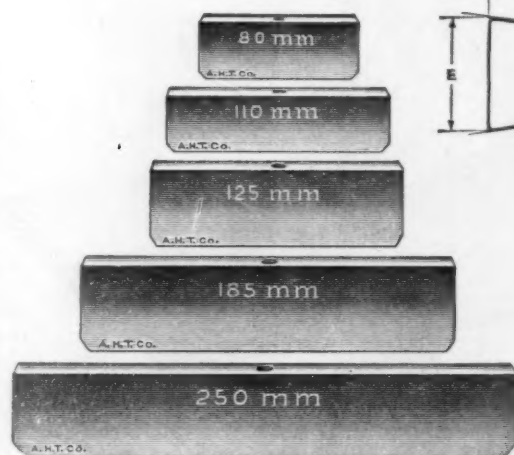
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7182-A

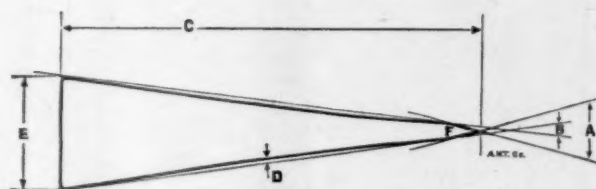


Fig. 1

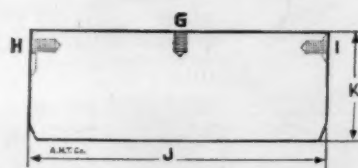
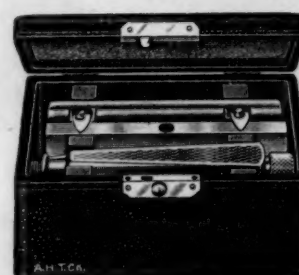


Fig. 2



7182-B



7182-C

MICROTOME KNIVES, SCHMID, A.H.T. Co. Specification. Of a new wedge-shape cross-section with a slight concavity on each side. The dimensions, i.e. thickness of back E, width C and thickness at F (see Fig. 1), have been changed to reduce the tendency to "chatter" in use—a fault common with knives too thin at point F. The inclusive angle A of the cutting bevel has been increased and tempering is controlled by Rockwell test.

Three threaded holes are provided in each knife as shown in Fig. 2: that at G for the No. 7207-G Schmid Hand Sharpener as listed overleaf, or for either No. 7204 or No. 7207 Fanz Automatic Sharpeners; that at H for the Bausch & Lomb microtome knife handle, and that at I for either the Spencer microtome knife handle or our No. 7184-A handle.

Knives without cases are shipped in a carton which protects against damage in transit only, but which is *not suitable for permanent laboratory storage*. Our cases are made of wood, covered with genuine leather, with hinged lid and knife support of hardwood with retaining clips. When knives are removed from and replaced in these cases with reasonable care, the cutting edge is entirely protected. All our microtome knives are sent out thoroughly greased so that care must be exercised in removing them from the case and in other handling because of the tendency to slip in the fingers. These accidents involve, not only damage to the knife edge, but serious personal injury.

In specifying the dimensions of the knives, "total length" refers to J of Fig. 2; "width of blade" refers to K of Fig. 2; and "thickness of back" to E of Fig. 1.

7182-A. Microtome Knives Schmid, A.H.T. Co. Specifications, as above described. Knife only, without leather case.

Total length, mm	80	110	125	185	250
Width of blade, mm	30	30	40	45	45
Thickness of back, mm	8	8	12	12	12
Each, in shipping carton	5.00	6.75	9.00	14.00	18.00
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7182-B. Ditto, i.e. knife only, but in leather case.....

Code Word	7.50	9.50	12.00	17.50	21.75
	Kepmu	Kepnr	Kepop	Keppn	Keprj

7182-C. Ditto, but with honing back and handle, complete in leather case

Code Word	12.00	14.00	16.50	25.50	31.75
	Keqar	Keqel	Keqib	Keqko	Keque

NOTE—The two larger sizes, i.e. 185 mm and 250 mm, are furnished with an additional small handle for screwing into the opposite end of the knife.

See overleaf for description of the Schmid Hand Microtome Knife Sharpener.

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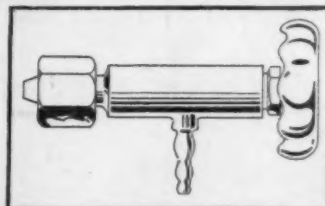
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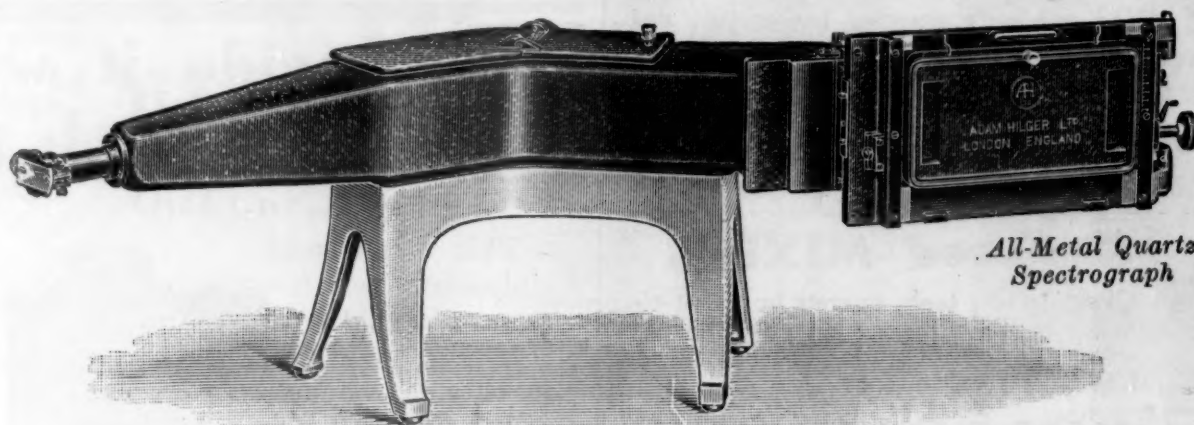
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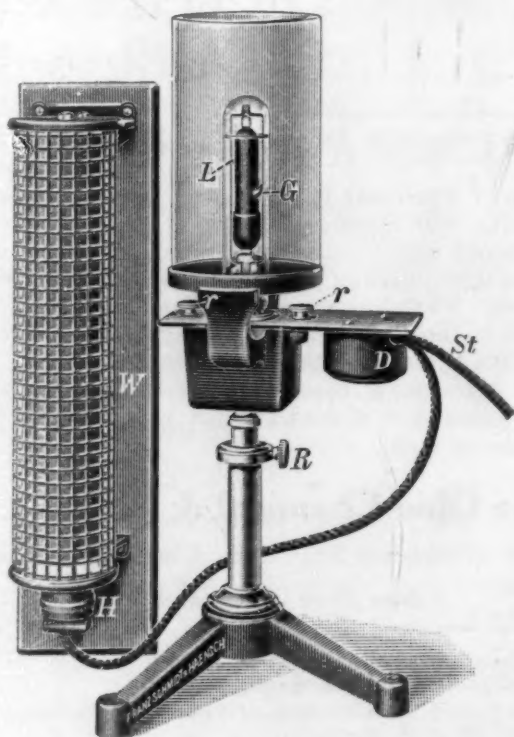
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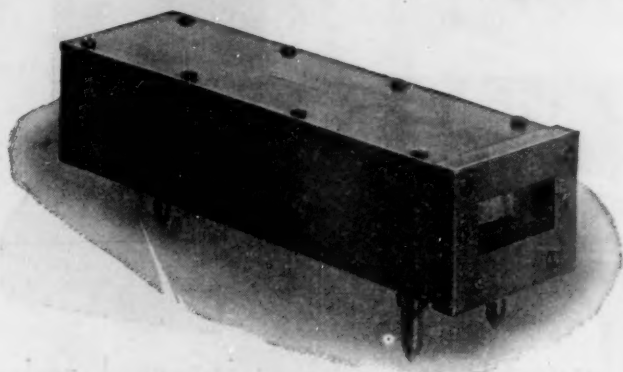
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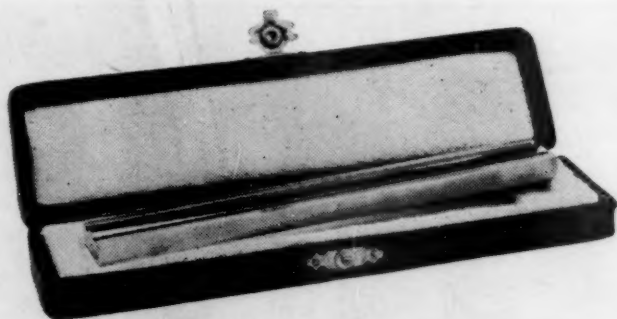


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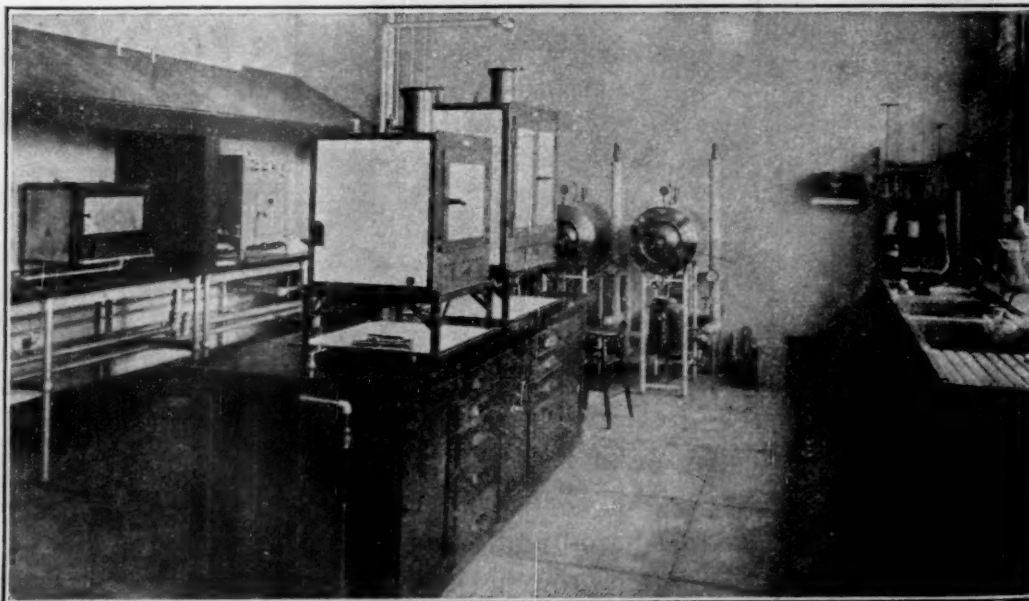
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